D. Main Section of the proposal

1. OVERALL AIM & OBJECTIVES:

Surgery represents an excellent opportunity to implement tobacco interventions. Smoking increases the risk for several perioperative complications, and cessation can significantly decrease risk. Furthermore, surgery represents a "teachable moment" for smoking cessation, as it can prompt abstinence even in the absence of interventions. Indeed, the PI has shown that approximately 1 in 12 of all quit events in older U.S. residents can be attributed to undergoing surgery.[1] Even smoking cessation within 12 hours of surgery can be helpful from a cardiovascular standpoint as carbon monoxide and nicotine return to normal levels.[2] Annually, an estimated 10 million procedures are performed on patients who use tobacco in the U.S., so the potential reach and public health benefit of tobacco interventions systematically applied to the this population is considerable. However, we have shown in studies conducted in both the US and other countries that clinicians in general, and surgical specialists (anesthesiologists and surgeons) in particular, are not taking advantage of the opportunity to intervene in this setting.[3]

To remedy this state, surgical specialists should take a leading role in ensuring that surgical patients who use tobacco receive tobacco interventions. However, most have little training in or experience with tobacco control. The PI initiated and leads the ongoing Smoking Cessation Initiative of the American Society of Anesthesiologists (ASA), and has worked with several other surgical specialist groups to promote perioperative tobacco control. One strategy to increase the rate with which surgical specialists address their patients' tobacco use would be to incorporate training in tobacco control within their residency curricula, so that residents view addressing tobacco use as a part of their professional responsibilities. Efforts to provide such training have proven efficacious in primary care specialties, most notably pediatrics, but have not been attempted in anesthesiology or surgery. We have already performed extensive formative work (described in the following section) regarding such training among anesthesiology program directors and residents.

Our long-term goal is to increase the proportion of surgical patients who receive tobacco use interventions initiated by surgical specialists. The primary goal of this application is to develop, test, and disseminate a tobacco control educational module for residents in surgical specialties, using anesthesiology residents as the "test case". The rationale for the proposed research is that systematic education of surgical trainees will increase the proportion of clinicians who incorporate tobacco control into their routine clinical practice. Building on the results of our formative research among anesthesiology residents and program directors, and our previous curriculum work, we will develop an interactive internet-based educational module that teaches an Ask-Advise-Refer intervention approach. Three specific aims will be pursued:

Specific Aim 1.—Develop a internet-based interactive perioperative tobacco control education module for surgical specialty residents. We will build on our extensive experience with perioperative tobacco control to develop a universally-accessible, internet-based, interactive educational module. Elements of this process will include engaging an electronic learning design firm to assist in module design, and a significant pilot project to determine whether innovative elements of adaptive approaches and video-based modeling of behavior improve the efficacy and efficiency of education.

Specific Aim 2.—Evaluate the efficacy of the perioperative tobacco control education module. To evaluate the efficacy of the final module, we will conduct a randomized trial comparing the educational module with an existing online presentation on perioperative tobacco control, including pre-and post-test evaluation of knowledge and attitudes, and assessment of changes in practice as outcome.

Specific Aim 3.—Disseminate the tobacco control education module. Based on these results, we will disseminate the module to all of the 132 anesthesiology residencies in the US, and work with existing partners in surgical specialties to facilitate further dissemination to surgical residencies.

At the conclusion of this work, residents in all surgical specialties (22,247 residents at present) will have access to a centrally-hosted, validated internet-based interactive perioperative tobacco control educational module that incorporates innovative educational elements. The overall impact will be increased referral of the millions of patients who undergo surgery each year to tobacco treatment services.

2. Current Assessment of Need in Target Area

The PI has performed extensive work demonstrating that the time around surgery (the perioperative period) is an excellent "teachable moment" for smoking cessation.[1] Recent studies suggest that tobacco interventions applied in the perioperative period are highly efficacious, including specifically interventions incorporating varenicline as pharmacotherapy.[4] Although approximately 10 million smokers undergo surgery in the US each year, and many more in other countries around the world, the extensive work of the PI has consistently shown that few surgical patients receive tobacco interventions, and that very few surgical specialists provide them, with <5% of surgeons and anesthesiologists in the US[3] and in other countries such as China and Japan[5] providing any interventions or referring patients to others for interventions. Thus, there is a large world-wide population of surgical patients who could potentially benefit from behavioral and pharmacotherapy for nicotine addiction, but are currently not receiving interventions.

In response to this need the American Society of Anesthesiologists Smoking Cessation Initiative (ASASCI) was instituted by the PI in 2006 with initial funding and technical support by the Smoking Cessation Leadership Center. The ASASCI has since developed many tools to promote tobacco use interventions in surgical practice (www.asahq.org/stopsmoking) with a focus on the Ask-Advise-Refer (AAR) approach recommended by SCLC. We chose this approach recognizing that surgical specialists generally do not have the time or the training to engage in extended counseling and follow-up necessary for maximum efficacy – but they can effectively refer their patients to intervention services. In prior work, the PI showed that the AAR is efficacious, feasible and can be disseminated in anesthesiology practice.[6,7] The ASACI has continued a variety of efforts to do so, including the development of educational materials, promoting tobacco control as a quality measure through the Physician Quality Reporting System, inclusion of training in tobacco control as a practice improvement activity in the maintenance of certification process for board-certified anesthesiologists, and inclusion of tobacco control as one of the required subject areas in the board certification examination process by the American Board of Anesthesiologists (for whom the PI serves as a Director). For example, the PI has collaborated with the Rx for Change initiative at UCSF to disseminate a

basic internet-based curriculum to practicing clinicians who care for surgical patients (see rxforchange.ucsf.edu). However, the reach of this annotated PowerPoint presentation, which is lengthy, not interactive and is not designed to address trainees, has proved limited. Developing and disseminating an innovative, internet-based tobacco control educational module to every anesthesiologist in training fits perfectly within the strategic plan of the ASASCI and will ensure that every newly-trained anesthesiologist will have a firm foundation in tobacco control. The ASASCI also has established collaborations with other surgical specialists, including the American Academy of Orthopedic Surgeons, the Society for Thoracic Surgeons, and the American College of Surgeons, which represent potential avenues of dissemination for the curriculum, as the module will be designed to apply to trainees in all surgical specialties, not just anesthesiologists. With approximately 22,247 residents in training in the US in surgical specialties (personnel communication, Dr. Steven Rose, Dean of the Mayo Graduate School of Medicine), this could have a major impact on the numbers of smokers referred for interventions.

A recent survey of anesthesiology residents and program directors by the investigative team (now submitted for publication) shows that very few of the 132 anesthesiology residency programs (with approximately 6,000 residents in training) provide any training in tobacco control (<10%) and few residents discuss tobacco use with their patients, but that there is great interest among residents and program directors in incorporating tobacco control training into their programs. Highlights of findings include the following:

- Only 2% of residents or their staff currently provide any assistance to their patients to help them quit smoking, but 75% agreed that the perioperative period was an excellent time for patients to quit.
- 95% of residents indicated a willingness to incorporate the Ask-Advise-Refer approach in their future practices – if they knew how to do so.
- 91% of program directors would include an internet-based tobacco control module in their residency curriculum.

<u>These findings support a strong rationale for this proposal</u>: by filling the training gap, we can in the long-term best address the current practice gap between USPHS Guideline recommendations that clinicians provide tobacco interventions to all their patients, and actual practices. Given that surgical patients are highly motivated to improve their health, if consistently applied this approach will considerably enhance the reach of tobacco interventions, including both behavioral counseling and pharmacotherapy, in a population that might otherwise not consider utilizing tobacco use interventions.

Recent advances in educational technology make possible the incorporation of innovative features of e-learning that could improve the efficiency and efficacy of instruction. Two features of relevance to the present project are adaptive learning and incorporation of video clips.[8] As shown by Dr. Cook, adapting instruction to residents' baseline prior knowledge is a potential benefit of internet-based learning.[9] Postgraduate medical education requires efficiency as clinical demands increase and available time and work hours decrease. While some adaptive learning interventions have been described in the literature the studies have rarely compared to non-adaptive instruction, although there is some preliminary evidence to support increases in efficiency when applied to internal medicine residents.[9] Instruction on physician behavior or practice can include modeling examples. Frequently, practice or behavior modeling

can occur in video format through which the learner can view a correctly performed intervention. Research on the effect of video components in educational modules is scarce, but generally supports the its benefit in a variety of outcomes including improved self-efficacy, knowledge, adherence to evidence-based practice, guideline adherence, and intervention skills.[10,11] It is not known whether it is observation of the behavior itself which confers advantage, or whether simply reading a script exemplifying the desired behavior would be sufficient. The formative work proposed (Specific Aim 1) will provide important new information to fill these gaps, which could prove useful not only for this project in particular but for the field in general. We are fortunate that Dr. Cook, a national expert in e-learning in the health professions, is a part of the investigative team.[12]

3&4: Technical Approach, Intervention Design, and Methods; Evaluation Design

Specific Aim 1.—Develop a internet-based interactive perioperative tobacco control education module for surgical specialty residents. Informed by our prior survey of U.S. anesthesiology program directors and residents, the objective of this aim is to devise an interactive, internet-based education module for anesthesiology and surgery residents that motivates residents to incorporate tobacco interventions into their routine practices and specifically teaches the Ask-Advise-Refer strategy. To attain this objective, we will 1) determine module content by building on previously designed ASASCI and Rx for Change education for surgical specialists and additional recent additional evidence (e.g., the efficacy of varenicline in surgical patients)(Phase 1); 2) implement the module content determined in Phase 1 into an e-learning format, including an initial pilot testing phase, working with a leading electronic learning (e-learning) design firm (Phase 2), and; 3) in a more extensive pilot study determine whether two novel educational elements, a) adaptive learning or b) video or scripted modeling of desired behavior, contribute to the efficacy and efficiency of learning (Phase 3).

Phase 1. Determine module content. In this phase, building on our extensive prior experience with perioperative tobacco control, and utilizing the findings of our preliminary survey of anesthesiology residents which identified current gaps in knowledge and practice, we will determine module content. It will reflect the most recent evidence from the medical literature and incorporate elements of the ASASCI and Rx for Change materials along with results from our anesthesiology resident survey. Specific content to be covered will include: tobacco use epidemiology and economic implications, health consequences of smoking in general, complications of perioperative smoking, benefits of preoperative smoking cessation on surgical outcomes, surgery as an opportune time and teachable moment for long-term smoking cessation, the importance of surgical specialists in providing advice and referral to treatment, nicotine as an addictive substance, pharmacotherapy and counseling for treatment of tobacco dependence (including the recently-demonstrated benefit of varenicline in improving smoking cessation postoperatively[4]**),** and the Ask-Advise-Refer tobacco intervention technique. Preliminary goals and objectives have already been defined for the module (not included in this application for reasons of space).

Phase 2. Initial implementation and initial pilot testing. In this phase we will implement the module content determined in phase 1 into an e-learning format, including an initial pilot testing phase.

Implementation. We will work with a leading e-learning firm (Allen Interactions, Inc) to develop an interactive, internet-based module. This firm has a proven track record of successful e-learning projects performed with Mayo Clinic. The initial module that is produced will include several variable elements incorporating innovative educational approaches that will be evaluated in Phase 3. This will help us to determine the optimal elements to include in the final module (to be evaluated in Specific Aim 2). The variable components to be evaluated include 1) module adaptability wherein baseline knowledge will allow the learner to bypass certain portions of the content and 2) videos or scripts modeling the application of the Ask-Advise-Refer technique (see Phase 3 below for full description).

Pilot testing. For initial pilot testing of these versions, anesthesiology residents (n=55) at Mayo Clinic will be asked to participate. Requests for study participation will be through email with web-links to the module. Reminder emails will be sent out at 1 week intervals with pilot-testing taking place over a three week period. Participants will be assigned receive versions of the model that incorporate different combinations of adaptability and modeling elements.

Assessments. Five domains will be assessed in this initial pilot study and subsequent phases of this project. Items used to assess these domains have been used in our previous studies.[3]

Knowledge assessment: We will assess fundamental knowledge important to tobacco control (knowledge regarding pharmacotherapy such as varenicline) using the same questions used in our prior resident survey. A knowledge index is calculated as the sum of correct responses.

Attitudes and beliefs. We will utilize items used by our group in multiple studies to assess these constructs in anesthesiologists, surgeons, and trainees. They also include items related to risks and benefits of perioperative smoking abstinence, beliefs regarding anesthesiologists' responsibility to intervene and attitudes towards learning about tobacco control.

Tobacco control practices. We will again utilize items used by our group in multiple studies to assess these constructs in anesthesiologists, surgeons, and trainees. These items include queries regarding current performance of the "5 A" elements, and plans for performance after residency. We will also query specifically for performance of the Ask-Advise-Refer strategy.

Self-efficacy for tobacco interventions. According to Social Cognitive Theory, self-efficacy determines how capable one believes they are to organize and execute specific courses of action. A high level of self-efficacy among health professionals is associated with increased self-reported preventive care delivery, including counseling, and guideline adherence in various healthcare settings. Self-efficacy can be improved through training, successful individual performance, and strengthened in a variety of ways, including vicarious experiences (e.g., modeling the behavior of others). Self-efficacy will be measured using a modification of a previously validated 11-point ordinal scale, ranging from 0 ("not at all confident") to 10 ("extremely confident") regarding to confidence in providing the Ask-Advise-Refer tobacco control intervention.

Time to complete module. As time is limited in any residency training program, the efficiency of learning is a critical consideration – namely how long does it take to achieve a given standard of performance. We will thus measure the time spent on the module.

Analysis. For this initial pilot study, each version will include pre- and post-assessments administered immediately before and after the module. Preliminary assessment of treatment effect of the module on knowledge index and self-efficacy will be the primary focus of the assessment using Cohen's d. We will also examine the time needed to compare each version of the module. Additionally, narrative comments and suggestions for improvement or modification will be solicited at completion of the post-assessment portion of the module. Based on the results of these assessments, each version will be modified accordingly if necessary in collaboration with the e-learning firm.

Phase 3. Determine the utility of innovative module elements. In this phase we will determine whether two novel elements, 1) adaptive learning or 2) video or scripted modeling of desired behavior, contribute to the efficacy and efficiency of learning. This will allow for optimal construction of the final educational module that will be evaluated in Specific Aim 2. It will also further the evidence base for elements of e-learning generally that can improve educational outcomes.

Procedure. U.S. anesthesiology residency program directors who responded to our prior survey and expressed a willingness to be involved in a future tobacco control education module design work (n=67) will be contacted for confirmation of interest in allowing their residents to participate a randomized trial. Forty of these will be asked to forward an email with study module internet-link to their residents requesting participation in this trial, a method that we used successfully in our prior survey. The remainder of the program directors will be asked to participate in the later study described in Specific Aim 2. Based on the response rates achieved in our prior survey, we anticipate that approximately 500 residents will agree to participate in this phase. As in our prior work, program directors will be asked to send reminder emails to their CA-1 to CA-3 residents over a 3 week period. Residents who wish to participate will be directed to the education module study website maintained by us. Each resident will be asked to register by program and email address for follow-up assessment and informed that all information provided will be kept confidential. Each resident (not clustered according to program) will be randomized to one of four tobacco control education module interventions.

Intervention conditions. Each intervention will have the same didactic content determined in phase 1, but will differ in the innovative educational elements incorporated.

A. Control: This will be a standard interactive internet-based module. This module will be non-adaptive and not contain video or scripted dialogue of patient-physician interactions demonstrating the Ask-Advise-Refer smoking cessation intervention.

B. Adaptive: This version will allow residents to bypass components of the Control module content if a preceding question is answered correctly; residents will have a brief confirmation of the correct answer and the option of accessing more detailed content if desired. The questions will be presented throughout the module.

C. Video modeling: This version will contain videos of patient-physician interactions demonstrating the correct Ask-Advise-Refer brief smoking cessation intervention in pre-anesthetic medical evaluation clinics and pre-operatively before undergoing surgery. These videos have already been produced and are available on the Rx for Change website. Other than the video content this module will be the same as the control (i.e., not adaptive).

D. Scripted modeling: This version will contain the scripted dialogue from the videos. No video will be shown in this module. Other than content specific to the scripted dialogue this module will be the same as the control (i.e., it will not be adaptive).

Assessments. The same domains will be assessed as in the initial Phase 2 pilot study, namely completion time and as pre- and post-tests included immediately before and after completion of the module. In addition, we will also assess these domains in participants at 3 months after module completion to assess the persistence of any learning effects noted. This will also allow for assessment of any changes in practice, as it will be necessary to allow for some time to elapse after training for any changes in practice to be put into effect.

Analysis. We will assess changes from pre- to post-test for each item used to measure the domains (knowledge index; attitudes and beliefs; practices, and self-efficacy) by comparing the proportion of respondents who strongly agree or agree (e.g., it is my responsibility as an anesthesiologist to advise patients to quit smoking), or always or often (e.g., I advise my patients to quit smoking) for items with categorical responses, or scores for ordinal items (e.g., number of correct answers in the knowledge evaluation). The following comparisons will be made. Comparisons will be using appropriate tests for categorical and ordinal responses.

Control vs. Adaptive conditions (A vs. B). The primary analysis of interest here will be the ratio of change in each item to the time needed to complete the module, as an index of the efficiency of learning. This will determine whether, with the adaptive approach, similar changes in outcomes can be obtained with less time.

Video vs. Script (C vs. D). The primary outcome for this analysis will be self-efficacy for providing tobacco interventions. This will determine if observing the modeled behavior produces a greater increase in self-efficacy compared with simply reading a suggested script. We hypothesize that this will be the case.

Control vs. Video (A vs. C). The primary outcome for this analysis will be self-efficacy for providing tobacco interventions. This will determine whether behavioral modeling is efficacious in increasing self-efficacy.

With an estimated 125 residents receiving each intervention condition, we will have 80% power to detect a moderate and educationally-meaningful effect size (Cohen's d = 0.4) at the p=0.05 level for comparison of ordinal variables using t-tests to compare pre-post changes in knowledge and self-efficacy, and module completion time. If assumptions for parametric tests are not met, we will use nonparametric tests (Wilcoxon rank sum) for these analyses.

We will perform a similar analyses comparing pre-test assessment with the assessment at 3 months. In the case of variables such as knowledge and attitude, this will permit assessment of retention. It will also permit assessment of changes in practice, with comparisons of the proportions reporting utilization of the Ask-Advise-Refer strategy made using chi-square analysis.

Deliverable and expected results. At the conclusion of this aim we will have developed an educational module and have evaluated two novel education features designed to increase the efficiency and efficacy of the education. We anticipate that both of these features will be efficacious, and that we will incorporate these features into the final version of the module,

which will be evaluated in the next aim. Thus, the deliverable of Specific Aim 1 will be a internet-based interactive perioperative tobacco control education module for surgical specialty residents that incorporates innovative educational design features, ready for validation in Specific Aim 2.

Specific Aim 2.—Evaluate the efficacy of the perioperative tobacco control education module. As a final validation of the module, we will conduct another randomized trial comparing the educational module with an non-interactive online module presentation on perioperative tobacco control that provides equivalent content, including post-test evaluation of knowledge and attitudes, and assessment of changes in practice as outcomes. Note that this comparator condition (currently implemented as annotated PowerPoint presentation in the Rx for Change curriculum) was not utilized in Specific Aim 1 (rationale included in the following section). Demonstration of efficacy will be important in the efforts to disseminate the intervention (Specific Aim 3).

Procedure. Residents will be recruited to participate in a manner similar to that employed in phase 3 of Specific Aim 1, using email solicitations distributed by willing program directors. Based on responses to our prior survey, and excluding those residents in program who participated in the phase 3 of Specific Aim 1 study, we anticipate that approximately 25 program directors will agree to forward study invitations, such that approximately 350 anesthesiology residents will participate. Randomization will be to one of two tobacco control education module interventions without regard to residency.

Intervention conditions.

A. Control: This will be a non-interactive online module based on the current module available in the Rx for Change Curriculum, modified to be of approximately the same length as the experimental module and to delivery equivalent content. It will not have interactive elements, adaptation, or modeling elements. The rationale for using this as a control condition is that it represents the a standard perioperative tobacco control curriculum that is currently available on the internet, and thus is a fair comparator condition for our experimental intervention.

B. Experimental: This version will combine those elements shown to be efficacious in Specific Aim 1. We anticipate that this will include both adaptation and video modeling.

Assessments. The same domains will be assessed as in the Phase 3 pilot study as post-tests included immediately after completion of the module, as well as completion time. In this aim, we choose not to perform a pre-test assessment as the pre-test itself could provide an educational element to the control condition. With a sample size of approximately 175 per group and randomization, baseline attributes including knowledge (before completion of the modules) should be similar in the two groups. In addition to this immediate post-test assessment, we will also assess these domains in participants at 3 months after module completion to assess the persistence of any learning effects noted. This will also allow for assessment of any changes in practice, as it will be necessary to allow for some time to elapse after training for any changes in practice to be put into effect.

Analysis. We will compare between conditions post-test responses for each item used to measure each domain by comparing the proportion of respondents who strongly agree or agree (e.g., it is my responsibility as an anesthesiologist to advise patients to quit smoking), or

always or often (e.g., I advise my patients to quit smoking) for items with categorical responses using chi-square analysis. Ordinal responses (e.g., number of correct answers in the knowledge evaluation) will be compared using unpaired t-tests (or nonparametric tests if needed). We will perform a similar analysis comparing immediate post-test assessment with the assessment at 3 months. In the case of variables such as knowledge and attitude, this will permit assessment of retention. It will also permit assessment of changes in practice.

The outcomes of greatest interest for this analysis will be self-efficacy for delivering interventions at the immediate post-test and self-reported practices regarding delivery of the Ask-Advise-Refer at the three-month assessment. With approximately 175 residents in each experimental group, we will have 90% statistical power to detect an improvement in Ask-Advise-Refer performance rate from 20% to 35%, and 80% power to detect a small effect size (Cohen's d=0.3) for differences in self-efficacy.

Deliverable and expected results. At the conclusion of this aim we will have validated the educational model developed in Specific Aim 1 by comparing it to the current standard using a randomized trial. Thus, the deliverable of Specific Aim 2 will be a validated internet-based interactive perioperative tobacco control education module for surgical specialty residents that is ready for dissemination in Specific Aim 3. We will also prepare a manuscript describing the results of our work on Specific Aims 1 and 2 for publication. Although we anticipate based on existing literature that our newly-developed module will be superior to the existing module, if in fact the two are equivalent we will disseminate the newly-developed module in Specific Aim 3, as it will have post- test capabilities and other elements that make it suitable for wide distribution.

Specific Aim 3.—Disseminate the tobacco control education module. Once the module has been validated in Specific Aim 2, we will proceed with dissemination to all of the 132 anesthesiology residencies for incorporation into their educational curricula. We will also begin discussions with representatives from other surgical specialties to plan for the dissemination of the module to these programs as well.

Procedure. Through the ASASCI, the module will be hosted on the ASA server. This will ensure that the module is available to all residency program directors, and the long-term sustainability of the training as the ASA remains committed to the ASASCI. Also, by hosting in a central location, if any future modifications need to be made this can be easily done. This will also allow us to monitor the utilization of the module by anesthesiology residents. Although we will not collect individually-identifiable information from residents who utilize the module, we will collect year of training and residency identification information, which will allow us to generate reports to individual program directors regarding utilization by their residents. As we know the total number of anesthesiology residents in training at any given time, we will be able to know the reach of the educational intervention among our target audience. Although it will not be possible to track outcomes across all residency programs within the time and budget allowed with this funding mechanism, we would plan to repeat our resident survey at some point in the future after dissemination to estimate the overall impact of our program.

Availability of the module on the server will be advertised via direct communication with the program directors, and through articles in the ASA newsletter, which has proved an effective dissemination method in prior work by the ASASCI.

Finally, although we plan to utilize anesthesiology residents as the "test case" for module development and validation, it is intended to be used for residents in all surgical specialties. Thus, in the dissemination phase the PI will take advantage of existing interactions with other surgical specialists interested in perioperative tobacco control to initiate discussions to disseminate the module to these training programs as well. We will work initially Dr. John Maa at the American College of Surgeons (see attached letter of support).

Deliverable and expected results. At the conclusion of this aim we will have disseminated the module developed in Specific Aim 1 and validated in Specific Aim 2 to all of the 132 anesthesiology residencies in the US, including approximately 6,000 residents. We will have also initiated discussions with other surgical specialists to plan for dissemination to other surgical residents as well. Thus, the deliverable of Specific Aim 3 will be access to a centrally-hosted, validated internet-based interactive perioperative tobacco control education module for that will be available for all surgical specialty residents.

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E. Detailed Work Plan and Deliverables Schedule

The following summarizes the detailed plans described in narrative form in Section D.

Specific Aim 1. —Develop a internet-based interactive perioperative tobacco control education module for surgical specialty residents.

Phase 1. Determine module content (Months 1-3). Major tasks will include:

- Finalize module goals and objectives
- Create content to meet these goals and objectives

Phase 2. Initial implementation and pilot testing (Months 4-10). Major tasks will include:

- Produce initial electronic implementation of module with e-learning firm, including adaptation and modeling variations
- Initial pilot testing of module with Mayo Clinic anesthesiology residents
- Modification of module if necessary based on pilot testing

Phase 3. Determine the utility of innovative module elements (Months 11-15).

- To evaluate two innovative educational elements, conduct randomized trial involving anesthesiology residents, randomizing them to one of four intervention conditions that incorporate adaptive and modeling elements, comparing them with the module without these elements.
- Based on the results of the trial, finalize the educational module

Specific Aim 2.—Evaluate the efficacy of the perioperative tobacco control education module (Months 16-21). Major tasks will include:

- To validate the efficacy of the final module, conduct another randomized trial involving different anesthesiology residents, randomizing them to receive either a control module (modified from an existed annotated powerpoint presentation) or the experimental module developed in Specific Aim 1.
- Prepare a manuscript for publication describing the results of Specific Aims 1 and 2

Specific Aim 3.—Disseminate the tobacco control education module (Months 22-24). Major tasks will include:

- Host the final module on server
- Implement communications plan to the 132 anesthesiology residency program directors to communicate availability of educational module and promote its use
- Initiate tracking plan to provide long-term monitoring of module utilization
- Initiate discussions with other surgical specialists (e.g., American College of Surgeons) to promote dissemination in these specialties.

Timetable of deliverables.

Deliverables	Scheduled completion month
Specific Aim 1	
Phase 1	
Module goals and objectives	*1*
Module content	*3*
Phase 2	
Initial electronic implementation of module and variations	*7*
Pilot testing completed	*9*
Modified module ready for evaluation in Specific Aim 2	*10*
Phase 3	
Randomized trial evaluating innovated elements completed	*14*
Module finalized	*15*
Specific Aim 2	
Randomized trial validating efficacy of final module completed	*21*
Manuscript ready for submission	*24*
Specific Aim 3	
Module hosted on server	*23*
Communications plan to residency program directors completed	*24*
Discussions initiated with other surgical specialists	*24*