

***Grant Final Report***

---

**Grant ID: 1R21HS021002**

**Testing Clinical Decision Support for Treating  
Tobacco Use in Dental Clinics**

**Inclusive Project Dates: 09/30/11 - 09/29/14**

**Principal Investigator:**

Donna Shelley, MD, MPH

**Team Members:**

Marcy Hager, MA

Tuo-Yen Tseng, MA

Hieu Pham, MSPH

Andrew Schenkel, DDS

Yixin Fang, PhD

Elise Eisenberg, DDS, MA

Matt McGuirk

**Performing Organization:**

New York University School of Medicine

**Federal Project Officer:**

Steve Bernstein

**Submitted to:**

**The Agency for Healthcare Research and Quality (AHRQ)**

**U.S. Department of Health and Human Services**

**540 Gaither Road**

**Rockville, MD 20850**

**[www.ahrq.gov](http://www.ahrq.gov)**

## Structured Abstract

**Purpose/Scope:** Dental care settings remain a relatively untapped venue for treating tobacco dependence. To address often-cited barriers to treatment we developed a web-based clinical decision support system (CDSS) to guide dentists in providing evidence-based cessation assistance. The purpose of this pilot study was to test the impact of the CDSS on provider and patient level outcomes.

**Methods:** We used a cross sectional pretest posttest design to evaluate the CDSS in six general dental clinics in the NYU College of Dentistry. The primary outcome, rates of provider-delivered cessation assistance (i.e., referral to the NYS Smokers' Quitline and/or providing pharmacotherapy), was measured using patient exit interviews (PEIs). Quit attempts and smoking abstinence were assessed with 1-month follow up telephone surveys with patients who completed the pre and post intervention PEIs. We also conducted post intervention qualitative interviews with dental providers who used the CDSS.

**Results:** Based on PEIs, there were no significant changes in rates of cessation assistance. However, patient telephone surveys found that patients were significantly more likely to report a quit attempt and report reading the patient self-help material post intervention. They were also more likely to contact the Quitline. In qualitative interviews the CDSS was perceived as easy-to-use and useful, and providers trusted the information. CDSS has the potential to enhance quality and consistency of tobacco use treatment in dental health care settings but requires further testing in general practice outside an academic setting.

**Key Words:** smoking cessation; clinical decision support; dentist

<p>The authors of this report are responsible for its content. Statements in the report should not be construed as endorsement by the Agency for Healthcare Research and Quality or the U.S. Department of Health and Human Services of a particular drug, device, test, treatment, or other clinical service.</p>
--

# Final Report

## Purpose

With previous intramural funding we have developed a clinical decision support system (CDSS) to assist dentists in providing cessation assistance to patients who smoke cigarettes. The web-based CDSS was developed for use at the point of care to assist dentists in developing patient-centered recommendations for pharmacotherapy and facilitating referrals for additional counseling. The purpose of this study was to pilot test the impact of the CDSS on dentists' adherence to the Public Health Services Guidelines on Treating Tobacco use and Dependence (PHS Guideline) and on patient quit behavior using a cross sectional pre-test post-test design to address the following aims:

**Aim 1.** Test the hypothesis that a clinical decision support system (CDSS) in dental clinics will improve the rate at which dentists assist their patients with smoking cessation (i.e. refer to smokers Quitline and/or provide pharmacotherapy).

**Aim 2.** Assess whether the exposure to information and recommendations facilitated by the web-based CDSS tool for smoking cessation will: 1) increase the rate at which patients make at least one quit attempt in the month following the dental visit, and 2) increase the reported use of counseling and pharmacotherapy during those attempts over that observed with a smoking status clinical reminder system alone.

**Aim 3.** Guided by the Unified Theory of Acceptance and Use of Technology, explore factors associated with adoption of the CDSS into dentists' workflow through post intervention qualitative interviews.

The ultimate goal of this research is to provide new knowledge to accelerate the translation of effective tobacco dependence treatment into the routine care delivered by dental professionals serving vulnerable populations with the highest risk of tobacco-related morbidity and mortality.

## Scope

Despite considerable progress, smoking remains the leading preventable cause of death in the United States, responsible for 435,000 deaths annually and \$157 billion in health-related economic losses.<sup>1,2</sup> Based on a meta-analysis of over 8000 tobacco cessation studies, the 2008 U.S. Public Health Service (PHS) Guidelines *Treating Tobacco Use and Dependence* establishes that tobacco dependence treatment, including cessation pharmacotherapy and counseling, can produce significant and sustained reductions in tobacco use and should be delivered to all smokers seeking routine health care.<sup>3</sup> Although safe and effective treatments for tobacco dependence exist, only a small proportion of the 40% of smokers who try to quit each year use

cessation therapies.<sup>1,3,4</sup> Effective treatment is particularly under-utilized among low income and ethnic/racial minority smokers.<sup>5</sup> Unfortunately, of those untreated who try to quit each year only 3-4% are likely to succeed compared with 22% of those who receive medication and brief counseling.<sup>3</sup>

Dentists are in a position to improve upon cessation rates because over 50% of smokers visit a dentist each year.<sup>5</sup> Dental care settings have several advantageous features for reaching smokers for delivery of tobacco cessation treatment including: 1) regular access to a broad proportion of the population with 62.8% of 18-64 years old and 50% current smokers reporting at least one annual dental visit;<sup>6,7</sup> 2) access to patients who do not receive other healthcare services (10% of dental patients do not regularly see a physician);<sup>8</sup> 3) multiple dental visits are common enabling repetitive provider attempts at tobacco intervention;<sup>9</sup> and 4) a recent meta-analysis and review article provide evidence that cessation assistance delivered by dental professionals can increase tobacco use abstinence.<sup>10,5</sup> Recognizing the important of dentistry in tobacco control efforts, Healthy People 2020 includes, as a key objective, improving screening and cessation counseling rates in dental care settings.

National surveys indicate that dental providers are increasingly screening for tobacco use and offering brief advice however, only 10-25% dental health professionals are routinely delivering cessation assistance (i.e., cessation pharmacotherapy and/or referral for cessation counseling).<sup>11-13</sup> Explanations for the failure of dentists to consistently provide smoking cessation interventions include lack of time, limited training in behavioral assessment and intervention, a lack of office-based systems to facilitate preventive care and a lack of referral resources, as barriers to addressing their patients' tobacco use.<sup>13-16</sup> Improving clinical adherence to the PHS Guidelines in dental settings is stymied by the limited research on system changes necessary to implement tobacco use treatment into routine dental care.

Clinical decision support systems (CDSS) have the potential for improving guideline adherence. In comparison to a paper-based reminder system, a CDSS can provide more up-to-date and accurate information about the elements of the PHS Guideline, and facilitate interventions that are more patient-specific and intensive and therefore effective.<sup>17-21</sup> However, we are aware of only one study examining the use of CDSS to improve adherence to clinical guidelines for treating tobacco use in dental practices and this study did not examine patient level outcomes.<sup>22</sup> To fill this gap, with intramural funding, we developed a CDSS, based on the PHS Guidelines. To develop the CDSS from a user's perspective we employed a three-phase development process of definition, usability testing and clinical testing recommended by Wyatt and Spiegelhatter.<sup>23</sup> This required a multi method approach that included convening and consultation with an expert panel, surveys of stakeholders, iterative usability testing with providers, and then pilot testing in one of the 14 New York University College of Dentistry general dental clinics. This pilot study was the next phase of research in the development and testing of the CDSS.

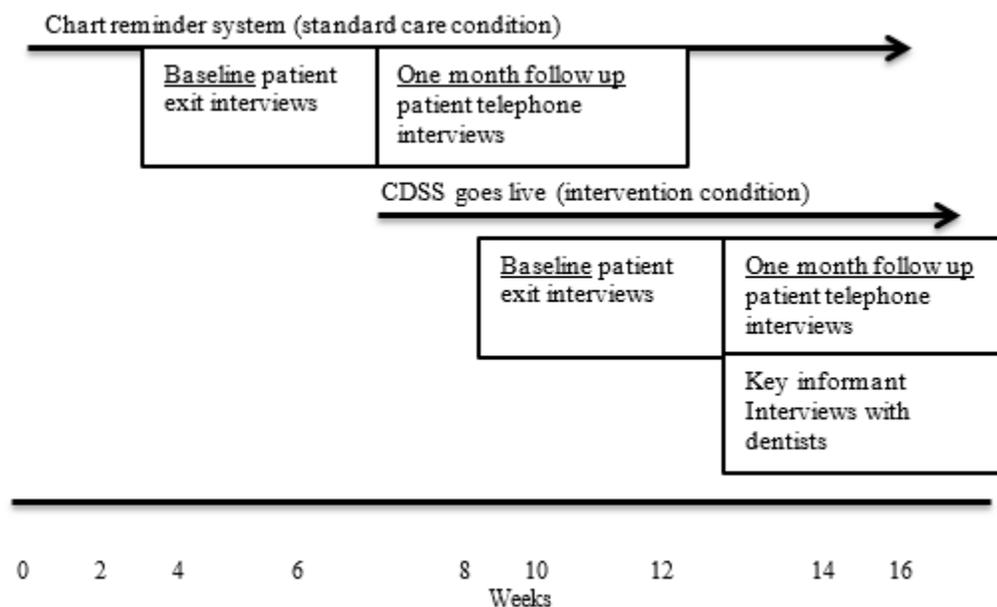
## **Methods**

### **Study Design**

We performed a pretest, posttest clinical trial of the CDSS in each of six general dental clinics at the NYUCD. The timeline for this study is depicted in Figure 1. Cross sectional patient

exit interviews (PEIs) conducted before and after the CDSS implementation were designed to provide an efficient estimate of the effect of the CDSS on dentists' adherence to PHS Guidelines (Aim 1). Patients who completed the PEIs at both time periods were also asked to complete a telephone survey one month after this visit to assess quit attempts and smoking abstinence (Aim 2). We enrolled the 6 sites in two waves with two sites in the first wave starting in year one and four sites in the second wave in year two. The timing of each wave was scheduled to account for student graduation in May and clinic closings for two weeks in December and August. We conducted post intervention semi-structured interviews with dentists who used the system during the intervention period to obtain more detail on the usability and acceptability of the system (Aim 3).

**Figure 1. Study Design**



## Conceptual Framework

The data collection and evaluation of AIM 3 was guided by the Unified Theory of Acceptance and Use of Technology (UTAUT), which posits four core determinants of behavioral intention and usage (perceived usefulness, perceived ease of use, social influence and facilitating conditions). UTAUT formulated a unified model that integrates elements across several behavioral theories.<sup>24</sup>

## Study Sites

We randomly selected 6 NYUCD general dental clinics (there are a total of 14). Two clinics were excluded because they had participated in piloting the CDSS in the development phase. The NYUCD clinics are the single largest safety net provider of dental care in New York State. The NYUCD clinics provide comprehensive oral care for approximately 124,000 outpatients per year. In terms of patient demographics, 65% self-identify as either African American or Hispanic and 56% receive Medicaid. Each of the 14 clinics is staffed with one dental practice director, an

administrator, 45-50 dental students (3<sup>rd</sup> and 4<sup>th</sup> year) and seven dental faculty who provide supervision. All clinics have reliable WiFi access.

## Study Conditions

**Standard care.** Standard care included a *clinical reminder system* in the paper chart, a “*prescription pad*” with the quitline number, provider training and availability of *free nicotine replacement therapy (NRT)* at the point of service. At the start of the study the paper chart already included a clinical reminder system for tobacco use screening. Dr. Shelley conducted a standardized one-hour training, based on the PHS Guidelines, that included consequences of tobacco use and oral health, how to offer brief counseling and an overview of the FDA approved pharmacotherapy and prescribing information. The NYUCD also offers two weeks of free nicotine replacement therapy (gum, patch and lozenge) as standard of care. Dental providers who practice in the NYUCD clinics can provide NRT to their patients who smoke during the dental visit. To facilitate appropriate prescribing behaviors dentists/students were provided an algorithm for prescribing NRT based on baseline cigarette use. The NRT is conveniently located in a supply room accessed frequently by dentists when they pick up their instruments. The prescribing algorithm was posted on a paper form at the supply room. A tracking system was also in place that required dentists to document, on a standard form, the dose, type of NRT, signature of the supervising dental faculty and patient record number. The forms were given to the supply room staff prior to their dispensing the medication. Dental students were able to prescribe other FDA recommended pharmacotherapy, but this required a prescription to be written by their supervising dental faculty.

## Intervention Condition.

**Clinical Decision Support System.** The paper chart remained unchanged during the intervention period. The CDSS was a stand-alone tool because the sites were not yet using an electronic record. Dentists/dental students were told to continue to screen for tobacco use and document smoking status in the paper chart. If the patient was a smoker the provider now had the option of accessing the web-based CDSS through their smart phone, ipad, tablets or other devices that they had at chair side. The CDSS is accessed using a wireless local network to communicate via a web browser with a server that acts as a central repository for both patient and guideline information, and that compiles and prints patient specific documents (Figure 1). Providers had to log into the system so that we were able to capture data on use by individual provider. Once logged in the system starts by asking the dentist to document the number of cigarettes the patient smokes per day and then takes them through an algorithm depending on the information they enter on each web page (Figure 2). For example, if the patient is not interested in quitting the CDSS will take the provider to the final page to print a handout with information on how to contact the Quitline. If a patient is interested in quitting and interested in using medication to quit, the CDSS will assist dentists in recommending and prescribing approved pharmacotherapy based on the number of cigarettes the patient smokes per day and any contraindications noted.

The pharmacotherapy options were limited to the patch, gum, lozenge and varenicline. At the end of each encounter the system printed a tailored handout for the patient listing the specific recommendations, instructions on how to use the medication they were prescribed, and cessation resources including the New York State Quitline number and numbers for other cessation

programs. For patients interested in having the New York State Quitline contact them, the providers were able to print a fax referral form that administrative staff faxed to the New York State Quitline. The Quitline, when receiving these referrals, provides proactive telephone counseling. Two additional forms were available; one form was the NRT tracking form that the students were required to give to the supply room staff to obtain the NRT. This was prepopulated based on the dentists' entries. Finally, the system printed a record of the encounter that became part of the paper chart record. The printing function required that the provider simply click print at the end of the visit and all documents were printed to a local printer that was conveniently located at the registration desk.

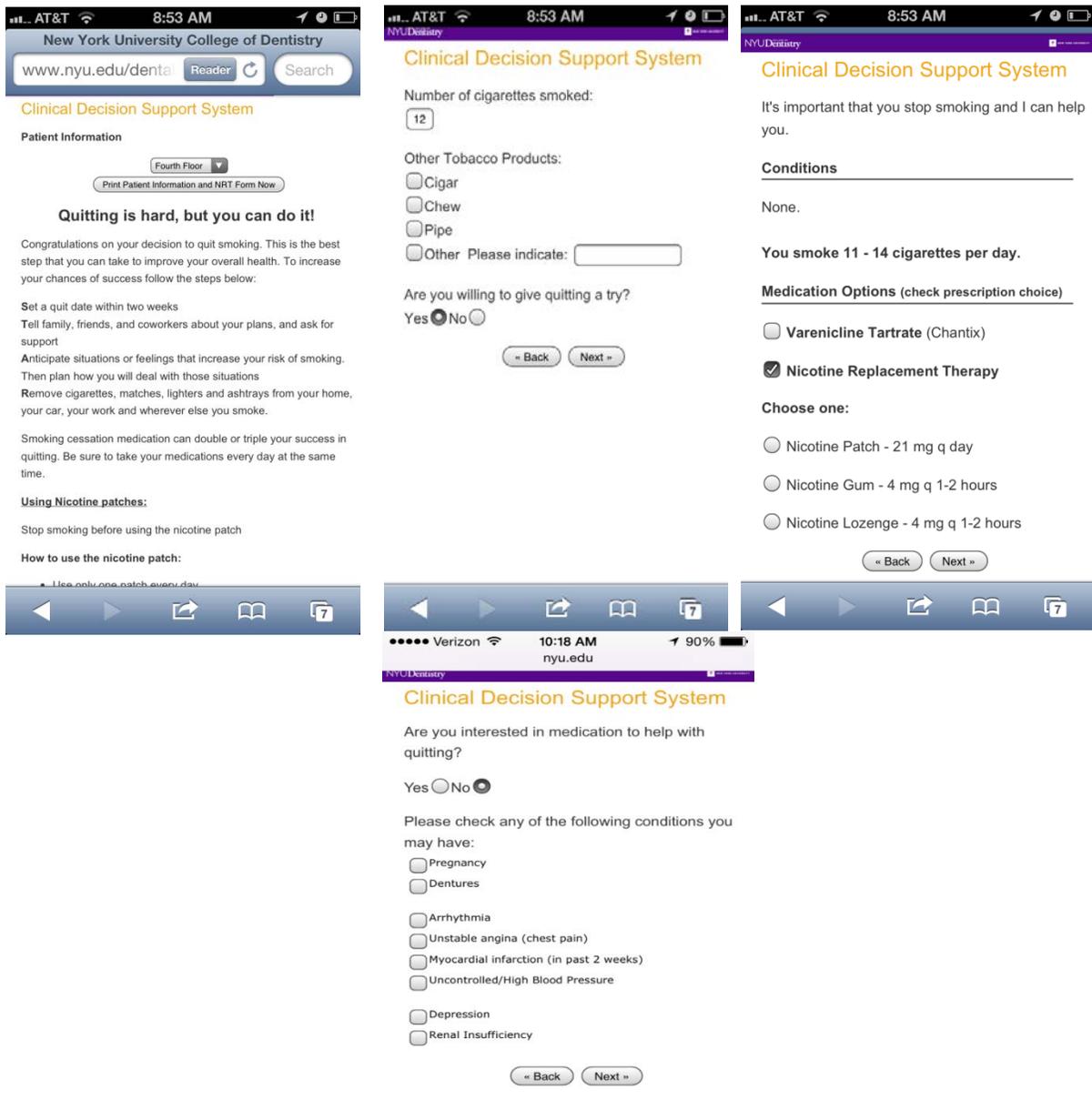
**Training.** The PI conducted a 30-minute training on how to access and use the CDSS. Students were asked to bookmark the website to make it easier to access. After the first wave of sites completed the study protocol, based on qualitative interviews with clinicians from this first wave and lower than expected usage, we added another component to the training. This included a detailed presentation on how to add the website link to their home screen to make it easier to access and a tutorial in which the trainer took students through two cases using the website. A booster training was conducted 2 weeks after the initial trainings to discuss and address challenges with using the CDSS. Based on feedback from students in the first wave of study sites, we provided small financial incentives for the highest users in the wave 2 sites that were provided twice during the intervention period (\$30 for 1st place, \$20 for 2nd and \$10 for 3<sup>rd</sup> across all 4 clinics). The dental school has a history of providing incentives (non-financial) to students for adhering to certain clinical guidelines; therefore, in consultation with the leadership, we decided to add the incentive component to align with NYUCD current practices.

Figure 2. Workflow Example



- 1) document smoking status in paper chart, 2) go to website if patient is a smoker and use CDSS to assess interest in quitting and if interesting, willingness to use medication, 3) If willing to use medication system will take provider to new page where they can obtain prescribing information, 3) print tailored handout for ALL patients (includes instructions for using medication if relevant), 4) print fax to quit form if patient agrees to be contacted by the quitline, 5) print chart note that summarizes encounter.

**Figure 3. Sample screenshots of the CDSS Tool**



## Outcomes and Assessments

**Primary outcomes.** The primary outcome was provider adherence to the PHS Guidelines, which was measured as the proportion of current smokers who reported receiving either pharmacotherapy (varenicline prescription or NRT at point of service) or referral to a counseling resource (i.e., NY State Quitline). To assess the primary outcome of provider adherence to tobacco use treatment guidelines, we conducted patient exit interviews with a cross sectional sample of smokers pre and post-intervention at each of the study sites. Patient questionnaires conducted at the point of service are considered to be the optimal non-observational method for measuring provider delivery of outpatient treatment. The Patient Exit Interview (PEI) is a brief

patient-reported measurement tool for the assessment of provider delivery of tobacco use treatment.<sup>25</sup> The questions assess the full spectrum of PHS guideline recommended care. For example, patients are asked if their provider advised them to quit, offered cessation counseling and/or discussed cessation medications. Prior to, and starting 2 weeks after the CDSS was implemented, consecutive patients were approached during their clinic visits by trained research study assistants to determine smoking status and to obtain consent for the exit interview and follow up telephone surveys (see below). Patient eligibility included: 1) age 18 or over; and 2) active smokers defined as those who report smoking within the past 7 days.

**Secondary outcomes.** To assess patient quit attempts and smoking abstinence we conducted follow-up telephone interviews, one-month post dental visit, with smokers who complete the PEIs.

**Table 1. Measures and data sources for each of our three aims**

	<b>Variables</b>	<b>Data source and Collection</b>	<b>Administration</b>	<b>Aim</b>
<b>Primary outcome</b>	Provider delivered cessation assistance	Cross sectional PEIs	Pre and post intervention	1
<b>Secondary outcomes</b>	Patient quit attempts (e.g., “Since your visit, have you stopped smoking for 1 day or longer because you were trying to quit?”), and smoking abstinence	Telephone interviews	Pre and post one month after dental visit	2
	Use of pharmacotherapy or counseling during quit attempt (e.g. “After your visit, did you contact the New York State Quit Line, or your local smoking cessation program, or another quit smoking program?”)	Telephone interviews	Pre and post one month after dental visit	2
	Patient satisfaction with dentist/associate dental student	Cross sectional Patient exit interviews	Pre and post Intervention	
	Patient rating of helpfulness of the CDSS and handouts	Patient exit interviews	Post intervention	
<b>Use and Acceptability of CDSS</b>				
Measures of CDSS use	Patient report of dentist use of CDSS	Exit interviews	Post intervention	3
	Aggregate data on accessing of CDSS screens by each dentist	CDSS server log	Post intervention	3
	Generation of patient handouts	CDSS server log Exit interviews	Post intervention	3
	Dentist self-reported use	Semi-structured Interviews	Post intervention	3
Acceptability	Dentists and staff opinions on perceived value and barriers to use	Semi-structured Interviews	Post intervention	3
	Dentists and staff opinion on effect of CDSS on clinic workflow	Semi-structured Interviews	Post intervention	3

**Acceptability and usability.** After completing collection of the post-intervention patient exit interviews we conducted semi-structured interviews with 5 students in the first wave of sites (2 sites) and 19 in the second wave of 4 sites for a total of 24 interviews. We interviewed only students who had used the CDSS at least once during the study period. Interviews assessed clinicians' perception of the value and utility of the CDSS as well as potential barriers for integrating the system into routine practice. We also downloaded from the server the aggregate number of times that unique dentists accessed the various CDSS screens by day as a measure of the range and frequency of CDSS use by the dentists.

## Challenges Affecting the Study Design

**Hurricane Sandy.** On October 29<sup>nd</sup>, 2012, two weeks after we implemented the CDSS in the second wave of sites (conducted training and went live), Hurricane Sandy hit New York City. This was exactly the timeline for starting the post intervention patient exit interviews to assess impact of the CDSS in this wave of sites. NYU was severely affected. The storm required shutting down the NYU College of Dentistry for one week. Once reopened, patient flow did not return to typical levels for at least one month and many of the providers were not back on their usual schedules because of damage they had experienced to their own homes. Therefore, we decided to exclude patient exit interviews conducted in the three-week period after the storm and extended the timeline for use of the CDSS and the post intervention PEIs to obtain the target of 40 smokers per site. The booster training was also delayed but occurred 5 weeks after Sandy which was consistent with the 2 week post intervention timeline for this training given that we restarted the clock for the intervention period.

**Recruitment of community based practicing dentists.** We originally planned to use the same study design from the NYUCD dental clinics with a community-based dental clinic however that clinic closed at the start of this study. We were still committed to pilot testing the CDSS with practicing dentists and attempted to implement the protocol in the NYUCD faculty group practice (FGP). However, after several weeks we were not able to reach our target for PEIs, and due to resource constraints we were forced to discontinue data collection. We were able to recruit two full time dental faculty from the FGP to use the CDSS in their private practice. After they used the tool for 6 weeks we used the same qualitative interview guides used in the dental school clinics to assess acceptability and usability of the CDSS.

## Results

Table 2 shows findings from the pre and post intervention PEIs with current smokers in 4 study sites. Chi-square and T-test analyses were conducted for categorical and continuous variables, respectively. We did not find significant changes across any of the guideline recommended care components (e.g., advice given). However, smokers were more likely to report that they were satisfied with their care in general in the CDSS post intervention period (i.e., while the dentists were using the CDSS).

**Table 2. Patient reports of receiving guideline recommended care pre and post intervention**

	<b>Pre (n=206 smokers)</b>	<b>Post (n=253 smokers)</b>	<b>p-value</b>
<b>Ask rate</b>	58.7% (n=121)	56.9% (n=141)	.25
<b>Advise rate</b>	53.7% (n=110)	46.4% (n=115)	.30
<b>Assess rate</b>	43.4% (n=89)	41.1% (n=102)	.29
<b>Referral to a cessation program</b>	20.0% (n=41)	16.1% (n=40)	.22
<b>Referral to New York State Quitline</b>	17.5% (n=36)	14.5% (n=36)	.54
<b>Discuss cessation medication</b>	23.4% (n=48)	20.9% (n=52)	.44
<b>Prescribe rate</b>	4.0 % (n=8)	3.3% (n=8)	.70
<b>Receive handout</b>	12.2% (n=25)	6.3% (n=15)	.07
<b>Mean score: Satisfaction with help about quitting smoking (5-point scale)</b>	3.88 (SD=0.99)	3.83 (SD=0.91)	.62
<b>Mean score: Satisfaction with care in general (5-point scale)</b>	4.54 (SD=0.82)	4.73 (SD=0.64)	<.01**

Table 3 shows findings from the telephone surveys conducted one-month after the patient’s dental visit. These surveys were conducted with patients who completed the PEIs. The response rate was 68.1%. Post intervention (i.e., while the CDSS was live) smokers were more likely to report a quit attempt (p=.03), and more likely to report contact with the New York State Quitline (p=.02). Post intervention smokers were also more likely to report reading self-help material (p<.001).

**Table 3. Results of patient telephone surveys one month after the dental visit**

	<b>Pre (n=151)</b>	<b>Post (n=185)</b>	<b>p-value</b>
<b>7 Day Abstinence</b>	7.9% (n=12)	9.7% (n=18)	.57
<b>Made quit attempt in last month</b>	48.9% (n=68)	61.1% (n=102)	.03*
<b>Got cessation medication since last dental appointment</b>	19.2% (n=29)	16.2% (n=30)	.47
<b>Contacted New York State Quitline or a cessation program</b>	7.3% (n=11)	15.7% (n=29)	.02*
<b>Read patient handout received from dentist</b>	43.0% (n=65)	60.9% (n=112)	<.001***

From October 22, 2012 to February 9th 2013, 59% of dental students in the four wave two study sites used the CDSS at least once with 331 distinct patients (based on data retrieved from the server). The CDSS logged all entries, which showed that 62% of smokers were willing to use medication to quit. Among those patients, 31% were prescribed the gum, 22% lozenge, 26% patch and 21% varenicline. Seventy percent of patients received the tailored patient education handout printed via the CDSS.

Table 4 shows examples of quotes related to the two main themes (perceived usefulness and perceived ease of use) that emerged from the qualitative interviews with dental students. Subthemes of perceived usefulness included supervisor and peer beliefs about the system (“I hear good things, mainly about how good it is and that it’s kind of like an instant respond sort of system. You know, you put the information in and it comes out right away”), job relevance, quality of output, and demonstrability of the results. Subthemes for perceived ease of use included convenience and time needed to complete the task. There was a consistency in the comments across these themes. Several acknowledged that they were reluctant to start using the system because they feared it would take longer than their typical approach, but once they tried it they found it simplified and shortened the process of providing cessation assistance. The students described greater confidence in treating tobacco use and particularly liked the ease of printing

tailored materials for patients. Some students would have liked additional guidance and information. For example, one student suggested more guidance in how to assess motivation and another wanted a place to document information about past cessation attempts. However, the majority of comments that were not describing the benefits of using the system focused on how it could be further improved and even expanded to include other risk behaviors like alcohol use. Faculty similarly found the CDSS useful and easy to use (Table 4.b.). Faculty and students felt an app would be easier to use and did not appreciate the time they needed to log into the site. Faculty also suggested a link to the patient’s pharmacy to increase ease of prescribing, a function that will be available once the clinics move to an electronic record.

**Table 4 a. Findings from qualitative interviews with dental students. (N=24)**

<b>Perceived usefulness</b>
<ul style="list-style-type: none"> <li>○ Before...I was introduced [to the CDSS] ...I never prescribed...or talked much about tobacco cessation. So actually I have started using it once I got the app.”</li> <li>○ “It is helpful because before that if I need to give anything to my patient, it’s just going to be...telling them and their listening and whatever they remember out of that. But if I have something to offer them something like a paper which everything is written, it’s self-explanatory, then it helps them.”</li> <li>○ “It’s really easy to print information for the patient and it’s great that it’s specific to the medication that you’re giving them too.”</li> </ul>
<b>Perceived ease of use</b>
<ul style="list-style-type: none"> <li>○ “You don’t have to memorize anything, you just know if the patient smokes how many cigarettes, just put that in and it does that work for you.”</li> <li>○ “I think it works really well. It’s really simple and really quick. I think that’s a plus, that it’s not like a whole bunch of questions to answer. It’s just kind of like one, two, three and it’s done.”</li> <li>○ “This app, it’s in my cell phone, so it’s easy for me to open it any time and use it.”</li> <li>○ “I think it’s very user friendly...the questions are very simple, straight forward. Putting the response in is easy and then it literally directs you where you need to go step-by-step.”</li> </ul>
<b>Provider suggestions for increasing quality and relevance the CDSS tool</b>
<ul style="list-style-type: none"> <li>○ “Asking a patient whether he or she has tried quitting before, so we can see motivation level.”</li> <li>○ “It’s simple and short but would prefer a little bit more detailed information...like from how many years he is smoking”</li> <li>○ “I think if we had digital charts instead of written charts it would...integrate easier”</li> <li>○ “If it was in the form of an actual app and not a web page, wherein you can constantly logged in with your NYU ID, that you’d have to keep going back and forth , logging yourself in”</li> <li>○ “You can include information with alcohol, not just focus on the tobacco, maybe, include, make it an overall health approach</li> </ul>

**Table 4.b. Findings from interviews with faculty (n=2)**

<b>Perceived usefulness</b>
<ul style="list-style-type: none"> <li>• I think it’s great, I inherently, I think its perfect for people who don’t have a lot of experience in helping people quit smoking. I think it covers all the bases. What I like about it is you can actually sit down with the patient and engage them in the process. I actually do it with the patient. I sit there and say, I have this great little app here, let’s go through this together. And I’ll ask them the questions and then they think its really cool because it comes out with an answer. And you go downstairs and you pick up the print-out. And then we give it to them and then we give them the gum or whatever it was. And they are impressed with that process.</li> <li>• I like the tool because it engages the patient in the process number one, I like that. And number two, you get the print-out at the end which I like.</li> <li>• I really liked it, I thought it was enormously useful. I particularly liked how there was algorithm for what to prescribe.</li> <li>• I think everyone wants to treat tobacco, but then they get nervous about prescribing, so the fact that the algorithm figured that out was really helpful.</li> </ul>

<b>Perceived ease of use</b>
<ul style="list-style-type: none"> <li>• It was a helpful step, without it everything else would breakdown. Now they had that and they could finish. That is the step where everything else stops because faculty don't feel comfortable; they don't know what to prescribe. So that tool would get us through to completing the process.</li> <li>• Every dentist should be able to do it.</li> <li>• I love that I can get that information right there chairside, sometimes you need it.</li> <li>• I think everyone wants to treat tobacco, but then they get nervous about prescribing, so the fact that the algorithm figured that out was really helpful.</li> </ul>
<b>Provider suggestions for increasing quality and relevance the CDSS tool</b>
<ul style="list-style-type: none"> <li>• The printout could be better customized for each patient, the print-out is fairly generic. For instance, could summarize the whole algorithm and then at the end could talk about each of the different pharmacotherapies with a little more detail. Not all the outputs showed 5 D's, which is very useful information.</li> <li>• Maybe linking directly to a pharmacy.</li> <li>• I think an app would be really helpful.</li> </ul>

## Discussion

We demonstrated the feasibility of engaging dental students and dental faculty in adopting a CDSS to facilitate the treatment of tobacco use. After the first wave of qualitative interviews and feedback from students in those two clinics, we made additional enhancements to the CDSS (e.g. printing prepopulated NRT order form) and made changes to the training. These included showing students how to add the website to the homepage on their phones or other devices to make access easier and faster and taking the students through case studies while they used the system in real time. This resulted in a higher rate of utilization in the second wave of four sites with 59% of students using the CDSS at least one time during the study period. Despite adoption of the CDSS, we did not find any change in provider adherence to guideline recommended care. This may be related to the extensive resources and training these dental students had *prior* to implementing the CDSS. Training on treating tobacco use was already a core component of the curriculum, self-help materials and free NRT was available, and an algorithm for prescribing NRT was posted at the supply area where NRT was obtained.

Although data collected via the PEIs did not demonstrate changes in provider behavior, qualitative interviews provided a more in-depth understanding of how users viewed the CDSS and provided valuable insights in terms of additional improvements that could be made to enhance usability and usefulness. Students and faculty consistently described the tool as simple to use and a trusted source of information that saved time by offering clear recommendations for pharmacotherapy and treatment options. With seven FDA approved medications and varying doses for NRT depending on the number of cigarettes smoked per day, prescribing can be challenging. Moreover, the option to print several helpful forms, including tailored information sheets for their patients (in English and Spanish) was viewed as a particular advantage over the current paper system and facilitated more meaningful interactions with patients.

A recent systematic review found that CDSSs are effective at improving health care process measures across diverse settings but evidence for clinical, workload and efficiency outcomes remains sparse.<sup>26</sup> In the only other study of CDSS in dental settings that we are aware of, embedding a computer-assisted tool in an EHR that suggested scripts for patient discussions about smoking cessation, improved provider-delivered tobacco cessation (i.e. increased rates of provider discussions with patient about specific strategies for quitting and referrals to a tobacco

quit line).<sup>24</sup> However, like most of the previous studies of CDSS, they did not measure patient outcomes. In our study, we found that patients with dental visits during implementation of the CDSS were more likely to report a quit attempt and contact with the New York State Quitline. Given the limitations of our design (described below) this finding may be unrelated to the CDSS intervention. However, taken together, the literature on CDSS, including our patient level findings and results from the qualitative interviews suggest that this is a promising tool for improving decision making and patient outcomes and deserves further study, particularly in dental settings. Future studies should focus on measuring clinical outcomes and barriers and facilitators of integrating CDSS into provider workflow.

There were several limitations to the study. First, we did not have a comparison group, and therefore changes observed in the patient level outcomes could have been due to other factors not related to the intervention. Second, Hurricane Sandy led to significant disruptions in clinic activities. However, we believe our approach, in which we excluded data collected during the first weeks the clinics were reopened and extending data collection, limited the impact. Third, the lack of integration of the CDSS in the patient chart may have been a barrier to using the system. Fourth, the system was tested primarily among dental students however; these students will be graduating into an environment in which they will increasingly be using technology in practice. Moreover, both students and the dental faculty who used the system and participated in qualitative interviews had remarkably similar comments about the benefits and limitations of the CDSS.

## Conclusion

In this study, we demonstrated the feasibility of implementing a CDSS in general dental clinics in NYUCD dental clinic. Qualitative assessments indicate the tool is simple to use, trusted by providers, and facilitates treatment. CDSS has the potential to enhance quality and consistency of tobacco use treatment in dental health care settings.

## Implications

Since the 2000 Surgeon General's Report, *Oral Health in American*, there have been numerous articles calling for a greater role for dentists in early detection and preventive services. As dental health care systems increasingly convert to EHRs, embedding clinical decision support is a promising strategy to support dental providers in expanding their scope of practice to include screening and treatment of risk behaviors and other risk factors that impact both oral and general health. Expanding EHR penetration in dentistry also provides opportunities for greater integration of oral health and general health care delivery systems to improve care coordination care processes and patient outcomes.

## References

1. CDC. Annual Smoking-Attributable Mortality, Years of Potential Life Lost, and Productivity Losses --- United States, 1997--2001. *MMWR Morb Mortal Wkly Rep.* 2005;54(25):625-628.
2. Mokdad AH, Marks JS, Stroup DF, Gerberding JL. Actual causes of death in the United States, 2000. *JAMA.* Mar 10 2004;291(10):1238-1245.

3. Fiore M, United States. Tobacco Use and Dependence Guideline Panel. *Treating tobacco use and dependence:2008 update*. 2008 update ed. Rockville, Md.: U.S. Dept. of Health and Human Services, Public Health Service; 2008.
4. Lopez-Quintero C, Crum RM, Neumark YD. Racial/ethnic disparities in report of physician provided smoking cessation advice: analysis of the 2000 National Health Interview Survey. *Am J Public Health*. 2006;96(12):2235-2239.
5. Gordon JS, Albert DA, Crews KM, Fried J. Tobacco education in dentistry and dental hygiene. *Drug Alcohol Rev*. 2009;28(5):517-532.
6. Dye BA, Morin NM, Robison V. The relationship between cigarette smoking and perceived dental treatment needs in the United States, 1988-1994. *J Am Dent Assoc*. 2006;137(2):224-234.
7. Manski RJ, Brown E. Dental Use, Expenses, Private Dental Coverage, and Changes, 1996 and 2004. In: 17 MCN, ed. Rockville, MD: Agency for Healthcare Research and Quality; 2007. MEPS Chartbook No.17.
8. Strauss SM, Alfano, M. C., Shelley, D., Fulmer, T. Identifying Unaddressed Systemic Health Conditions at Dental Visits: Patients Who Visited Dentists but Not General Health Care Providers in 2006. *JADA* 2010;submitted.
9. Gordon JS, Andrews JA, Albert DA, Crews KM, Payne TJ, Severson HH. Tobacco cessation via public dental clinics: results of a randomized trial. *Am J Public Health*. Jul 2010;100(7):1307-1312.
10. Carr AB, Ebbert JO. Interventions for tobacco cessation in the dental setting. *Cochrane Database Syst Rev*. 2006(1):CD005084.
11. Albert DA, Severson H, Gordon J, Ward A, Andrews J, Sadowsky D. Tobacco attitudes, practices, and behaviors: a survey of dentists participating in managed care. *Nicotine Tob Res*. Apr 2005;7 Suppl 1:S9-18.
12. Tong EK, Strouse R, Hall J, Kovac M, Schroeder SA. National survey of U.S. health professionals' smoking prevalence, cessation practices, and beliefs. *Nicotine Tob Res*. 2010;12(7):724-733.
13. Albert D, Ward A, Ahluwalia K, Sadowsky D. Addressing tobacco in managed care: a survey of dentists' knowledge, attitudes, and behaviors. *Am J Public Health*. Jun 2002;92(6):997-1001.
14. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA*. Oct 20 1999;282(15):1458-1465.
15. Albert DA, Severson H, Gordon J, Ward A, Andrews J, Sadowsky D. Tobacco attitudes, practices, and behaviors: a survey of dentists participating in managed care. *Nicotine Tob Res*. Apr 2005;7 Suppl 1:S9-18.
16. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA*. Oct 20 1999;282(15):1458-1465.
17. Garg AX, Adhikari NK, McDonald H, et al. Effects of computerized clinical decision support systems on practitioner performance and patient outcomes: a systematic review. *JAMA*. 2005;293(10):1223-1238.
18. Johnston ME, Langton KB, Haynes RB, Mathieu A. Effects of computer-based clinical decision support systems on clinician performance and patient outcome. A critical appraisal of research. *Ann Intern Med*. 1994;120(2):135-142.
19. Kawamoto K, Houlihan CA, Balas EA, Lobach DF. Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. *BMJ*. 2005;330(7494):765.
20. Shiffman RN, Michel G, Essaihi A, Marcy TW. Using a guideline-centered approach for the design of a clinical decision support system to promote smoking cessation. *Stud Health Technol Inform*. 2004;101:152-156.
21. Shiffman RN, Liaw Y, Brandt CA, Corb GJ. Computer-based guideline implementation systems: a systematic review of functionality and effectiveness. *J Am Med Inform Assoc*. Mar-Apr 1999;6(2):104-114.
22. Rindal DB, Rush WA, Schleyer TK, Kirshner M, Boyle RG, Thoele MJ, Asche SE, Thyvalikakath T, Spallek H, Durand EC, Enstad CJ, Huntley CL. Computer-assisted guidance for dental office tobacco-cessation counseling: a randomized controlled trial. *Am J Prev Med*. 2013 Mar;44(3):260-4
23. Wyatt J, Spiegelhalter D. Evaluating medical expert systems: what to test and how? *Med Inform (Lond)*. Jul-Sep 1990;15(3):205-217.
24. Venkatesch V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: Toward a unified view. *Mis Quarterly*. 2003;27:425-478.
25. Pbert L, Adams A, Quirk M, Hebert JR, Ockene JK,

- Luippold RS. The patient exit interview as an assessment of physician-delivered smoking intervention: a validation study. *Health Psychol.* 1999 Mar;18(2):183-8.
29. Bright TJ, Wong A, Dhurjati R, Bristow E, Bastian L, Coeytaux RR, Samsa G, Hasselblad V, Williams JW, Musty MD, Wing L, Kendrick AS, Sanders GD, Lobach D Effect of clinical decision-support systems: a systematic review. *Ann Intern Med.* 2012 Jul 3;157(1):29-43
30. Montini T, Schenkel AB, Shelley DR. Feasibility of a computerized clinical decision support system for treating tobacco use in dental clinics. *J Dent Educ.* 2013 77(4):458-62.

## List of Publications and Products

### Presentations

- Shelley D, Hager M, Tseng T, Shenouda M (August 2012). Creating an Impactful Dental Role in Tobacco Cessation. Poster Presentation. 2012 NYU College of Dentistry Research Program Presentation Session, New York, NY.
- Shelley D, Tseng T, Jannat-Khah D, Hager M (December 2012). Testing a Web-based Clinical Decision Support System on Smartphone Platform for Treating Tobacco Use in Dental Clinics. Poster Presentation. 2012 mHealth Summit, Washington, D.C.
- Shelley D, Tseng T, Pham H, Hager M, Eisenberg E, McGuirk M, Jannat-Khah D (November 2013). Usage of a Web-based Clinical Decision Support System for Tobacco Cessation Counseling. Oral Presentation. 141<sup>st</sup> American Public Health Association Annual Meeting, Boston, MA.
- Shelley D, Tseng T, Pham H, Hager M, Eisenberg E, McGuirk M, Jannat-Khah D (November 2013). Dental Providers Experiences using a Web-based Clinical Decision Support System for Tobacco Use Treatment. Oral Presentation. 141<sup>st</sup> American Public Health Association Annual Meeting, Boston, MA.
- Shelley D, Hager M, Eisenberg E, McGuirk M, Jannat-Khah D, Tseng T (February 2013). A Web-based Clinical Decision Support System for Improving Tobacco Use Treatment. Poster Presentation. 21<sup>st</sup> Annual Society for Research on Nicotine and Tobacco, Seattle, WA.
- Shelley D, Hager M, Eisenberg E, McGuirk M, Jannat-Khah D, Tseng T (February 2013). Dental Provider Experiences Using a Web-based Clinical Decision Support System for Treating Tobacco Use. Poster Presentation. 21<sup>st</sup> Annual Society for Research On Nicotine and Tobacco, Seattle, WA.

### Publication

Montini T, Schenkel AB, Shelley DR. Feasibility of a computerized clinical decision support system for treating tobacco use in dental clinics. *J Dent Educ.* 2013 77(4):458-62.

### Product

The CDSS tool has been updated based on feedback from the post intervention qualitative interviews. NYU College of Dentistry is currently transitioning to an electronic record and is integrating the CDSS into the workflow. Students continue to receive an annual training on treating tobacco use as a core component of the curriculum immediately prior to entering their clinical rotations and it now includes the study training on how to use the CDSS. Both integration into the electronic record and training embedded in the curriculum have ensured sustainability of the intervention. The PI of this project continues to partner with NYUCD to update the CDSS as the literature for smoking cessation evolves. We have also been in conversation with the American Dental Association to explore opportunities for dissemination to disseminate to other dental schools and dentists across the country.

# Appendices

## Appendix A: Sample Patient Information Sheet

(For patient prescribe combination NRT available in Spanish and English)

### Quitting Is Hard, But You Can Do It!

Congratulations on your decision to quit smoking. This is the best step that you can take to improve your overall health. To increase your chances of success follow the steps below:

- Set a quit date within two weeks.
- Tell family, friends, and coworkers about your plans, and ask for support.
- Anticipate situations or feelings that increase your risk of smoking. Then plan how you will deal with those situations.
- Remove cigarettes, matches, lighters and ashtrays from your home, your car, your work and wherever else you smoke.
- Smoking cessation medication can double or triple your success in quitting. Be sure to take your medications every day at the same time.

### Using Nicotine Gum:

Stop smoking before using the nicotine gum

#### How to Use the Nicotine Gum:

- Chew the gum very slowly until you feel a tingly or peppery sensation.
- Once you feel a peppery sensation, "park" the gum between your gum and cheek.
- When the peppery sensation fades, chew again until you feel the sensation.
- Do not swallow the gum.
- Do not eat or drink 15 minutes before or while using the gum.

#### How Long Should I Use the Gum?

- One piece of gum can last for 30 minutes.

- Use at least 9 pieces of gum per day.
- Do not use more than 24 pieces of gum per day.
- You should stop using the nicotine gum at the end of 12 weeks.

**Side Effects:**

- Local irritation of mouth and throat
- Upset stomach or indigestion
- Lightheadedness
- Hiccups

**Stop Use and Ask a Doctor if:**

- Mouth, teeth, or jaw problems occur.
- Irregular heartbeat or palpitations occur.
- If you get symptoms of nicotine overdoses: nausea, vomiting, dizziness, diarrhea, weakness and rapid heartbeat.

**Using Nicotine patches:**

Stop smoking before using the nicotine patch.

**How to use the nicotine patch:**

- Use only one patch every day.
- Place the patch on every morning and wear it all day.
- Put the patch on a clean and hairless part of your upper body (between your neck and waist or on your upper arms or shoulders).
- Rotate the location of the patch every day.

**Side Effects:**

- Skin rash: Apply the patch to a different location each day to prevent skin irritation.
- Insomnia: If you have trouble sleeping or have bad dreams, take the patch off before bedtime.

**Stop Use and Ask a Doctor if:**

- Severe skin irritation or discoloration occurs.
- Irregular heartbeats or palpitations occur.
- Severe chest pain or tightening occurs.
- Symptoms of nicotine overdose: extreme paleness, cold sweat, nausea, abnormal salivation, vomiting, abdominal pain or severe headache, disturbed hearing or vision, dizziness, mental confusion or weakness.

**Get free telephone counseling is available by calling:**

- NY State Quitline: 1-866 NYQUITS
- 1-800-QUITNOW (out of state)

**Or if you prefer in person counseling, call to make an appointment at a local cessation program:**

- Bellevue Cessation Program: 212-562-4748
- For other programs near you go to:
  - <http://www.nyc.gov/html/doh/downloads/pdf/csi/cessation-guide.pdf>
  - <http://www.nyu.edu/dental/tobacco/resourcesquitsmoking.html>

## Appendix B: Nicotine Replacement Therapy (NRT) Request Form

**Printed from CDSS with prepopulated information based on entries into the system**

GPD/Clinic: \_\_\_\_\_

Date: \_\_\_\_\_

**Indicate NRT requested below:**

- Limit of 1 box of NRT (or 2 if combination therapy is prescribed) per patient.
- Each box is a 2 week allotment.
- Patients may receive another 2 weeks of NRT at each follow up visit for a total of 6 weeks of treatment

Figure 4

<p><b>Patch:</b>   <input type="checkbox"/> 14mg   <input type="checkbox"/> 21mg</p> <p><b>Gum:</b>   <input type="checkbox"/> 2mg   <input checked="" type="checkbox"/> 4mg</p> <p><b>Lozenge:</b>   <input type="checkbox"/> 2mg   <input type="checkbox"/> 4mg</p>	<p><b>Please indicate how many cigarettes smoked per day:</b></p> <p><input type="checkbox"/> 6-10 cigarettes/day</p> <p><input checked="" type="checkbox"/> 10-15 cigarettes/day</p> <p><input type="checkbox"/> &gt; 15 cigarettes/day</p> <p>—</p>
---	---

6 - 10 cigarettes per day	10-15 cigarettes per day	> 15 Cigarettes per day
Gum or <u>Loz</u> : 4 mg q 1-2 hrs.	Patch: 21 mg q day  <b>OR</b>  Gum or <u>Loz</u> : 4 mg q 1-2 hrs.	Use combination therapy:  21 mg Patch q day + 2 or 4 mg Gum or Lozenge q 1-2 <u>hrs</u>

Patient Name: \_\_\_\_\_ Chart #: \_\_\_\_\_  
 Last            First

Student Name: \_\_\_\_\_ Student #: \_\_\_\_\_

Faculty Signature: \_\_\_\_\_ Faculty #: \_\_\_\_\_

**Supply clerk: To restock NRT, please call (646) 501-2530**  
**NOTE: Reorders take approximately 6-8 weeks to process.**  
Phone: (646) 501-2530 Fax: (646) 501-2706