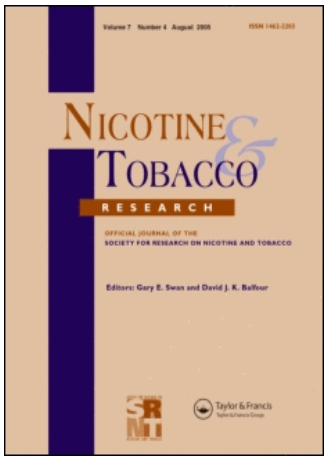

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Anticipating clinical integration of genetically tailored tobacco dependence treatment: Perspectives of primary care physicians

Elyse R. Park, Susan Kleimann, Julie A. Pelan, Alexandra E. Shields

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Emerging research will likely make it possible to tailor pharmacological treatment for individuals with tobacco dependence by genotype. This study explored primary care physicians' attitudes about the strengths of and barriers to using genetic testing to match patients to optimal nicotine replacement therapy. Four focus groups ($n=27$) were conducted, and data were analyzed using thematic content analysis. Physicians reported how likely they would be to offer patients a genetic test to tailor smoking treatment in response to three different scenarios that described characteristics of the genetic test based on published research. Respondents were on average 36 years of age; 59% were male and 67% were white. Physicians believed genetically tailored treatment may offer new hope to smokers trying to quit, yet they also noted several potential barriers to clinical integration. Barriers included erroneous assumptions by patients regarding the meaning of genetic test results, possible misinterpretation of information regarding racial differences in the prevalence of certain risk alleles, and potential discrimination against patients undergoing testing. Concerns increased dramatically when physicians were told that the same genotypes that would be identified to tailor smoking treatment also have been associated with increased risk of becoming addicted to nicotine, as well as other addictions and psychiatric disorders. Physicians were interested in the possibility of realizing improved smoking cessation outcomes through pharmacogenetic developments, but they also raised many concerns. Primary care physicians will need additional educational inputs and system support prior to integrating genetic testing for a common trait into their routine clinical practice.

Introduction

Tobacco use is the leading preventable cause of death in the United States. In 2000, approximately 8.6 million people in the United States had an estimated 12.7 million smoking-related conditions (Centers for Disease Control and Prevention [CDC], 2003). Although most smokers report that they want to quit, fewer than 10% are successful with unaided quits (CDC, 2000). Studies have shown that pharmacological treatments approximately double abstinence rates, compared with placebo (Lerman & Niaura, 2002). Nicotine replacement therapy (NRT) and non-nicotine medications such as bupropion can be effective treatments for tobacco dependence; however, significant individual variability exists in treatment outcome (Silagy, Lancaster, Stead, Mant, & Fowler, 2002) and little empiric data are available to guide individualized treatment (Hughes, Goldstein, Hurt, & Shiffman, 1999). Thus more work is needed to guide the matching of patients to effective pharmacological treatments.

The potential to use genetic information to tailor pharmacological treatment for individuals with tobacco dependence is an emerging area in tobacco control (Lerman & Niaura, 2002). Some evidence supports the role of polymorphisms, or genetic variations, in nicotine-metabolizing enzyme genes (Lerman et al., 1999; Lerman et al., 2001; Noble et al., 1994; Sabol et al., 1999; Spitz et al., 1998; Sullivan, Jiang, Neale, Kendler, & Straub, 2001). Research has identified genetic polymorphisms that predict response to different nicotine replacement

Elyse R. Park, Ph.D., Alexandra E. Shields, Ph.D., Julie A. Pelan, B.A., Institute for Health Policy, Massachusetts General Hospital/ Harvard Medical School, Boston, MA; Susan Kleimann, Ph.D., Kleimann Communication Group, Inc., Washington, DC.

Correspondence: Elyse R. Park, Ph.D., Institute for Health Policy, Massachusetts General Hospital, 50 Staniford Street, 9th floor, Suite 901, Boston, MA 02114, USA. Tel: +1 (617) 724-6836; Fax: +1 (617) 724-4738; E-mail: epark@partners.org

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treatments (Lerman et al., 2002; Lerman et al., 2004), suggesting that inherited differences in drug metabolism and drug targets have important effects on treatment efficacy (Evans & Relling, 1999; Poolsup, Li Wan Po, & Knight, 2000). One trial of transdermal nicotine patch focused on variations in the dopamine pathway (e.g., DBH and DRD2 genes) and found that the patch was significantly more effective than placebo for carriers of the A1 allele of the DRD2 gene but not for those homozygous for the more common A2 allele (Johnstone et al., 2004). However, the association of the DRD2 variant with abstinence at 6- and 12-month follow-up was observed only among women (Yudkin et al., 2004). An open-label trial comparing the transdermal nicotine patch to nicotine nasal spray examined the role of the OPRM1 gene (Lerman et al., 2004) and found that smokers carrying the OPRM1 Asp40 variant were far more likely than those homozygous for the Asn40 variant to be abstinent at the end of the treatment phase.

As this field advances, so does the potential for the role of primary care physicians in tailoring tobacco treatments by genotype to improve cessation outcomes for their patients (Roses, 2000). Pending validation of two large clinical trials assessing the clinical efficacy of pharmacogenetic tailoring of NRT (Johnstone et al., 2002; Lerman et al., 2004), genetic testing to tailor smoking cessation treatment may become available within the next few years. As a result, genetically tailored tobacco dependence treatment may emerge as one of the first major areas in which primary care physicians confront genetic testing for tailoring pharmacotherapeutic choices for a common health problem. However, several issues will need to be addressed before clinical integration of genetic testing, such as primary care physicians' limited training, knowledge, and comfort with clinical genetics and genetic testing (Burke & Emery, 2002; Caulfield, 1999; Demmer, O'Neill, Roberts, & Clay, 2000; Emery & Hayflick, 2001; Freedman et al., 2003; Hofman et al., 1993; Menasha, Schechter, & Willner, 2000; Rose et al., 2001). Other issues include physicians' resources to provide adequate informed consent and concerns about privacy and discrimination.

Some ethical considerations are relevant to clinical integration of genetic information into tobacco dependence treatment. One concern involves the pleiotropic nature of the genotypes (the fact that a genetic variant may be associated with many conditions). Genes identified with smoking behavior also have been associated with cocaine and alcohol addiction (Comings et al., 1997; Comings, Muhleman, Ahn, Gysin, & Flanagan, 1994) as well as with various psychiatric conditions (Billett et al., 1998; Comings et al., 1991; Comings et al., 1997; Comings, Muhleman, & Gysin, 1996; Muglia, Jain, Macciardi, & Kennedy, 2000; Rowe et al., 1998). The second concern involves the association between these pleiotropic variants and reported racial differences in the prevalence of the risk-related alleles, with a higher prevalence in (self-identified) African Americans than in Whites (Lerman et al., 1999; P. G. Shields et al., 1998). The danger here is that this information can be misreported as a causal relationship between race and stigmatizing behaviors, further perpetuating racial stereotypes about African Americans and substance use.

Given the impact of smoking on the public's health and the potential value of genetically tailored smoking cessation treatments, it is critical to ascertain physicians' perspectives on this issue and to identify potential barriers to the use of genetic testing for tobacco dependence in a clinical setting. The goals of this study were (a) to explore physicians' attitudes toward treatment strategies that include matching patients to smoking cessation treatment by genotype, and (b) to identify concerns that would need to be addressed prior to clinical integration of a genetic test to tailor smoking cessation treatment.

Method

Recruitment and participants

We recruited physicians through flyers posted at academic medical centers and announcements at primary care faculty meetings. Primary care physicians (internal medicine, general medicine, and family medicine practitioners) who dedicated a majority of their time in clinical practice were eligible to participate. We conducted four focus groups at academic medical centers in three locations: two in Washington, D.C.; one in Oak Park, Illinois; and one in Cook County, Illinois. Consent forms were collected prior to each group. Each participant was given $100 remuneration for his or her time. Each group lasted approximately 2 hours, was cofacilitated by the principal investigator and a Ph.D.-level communication expert, and was recorded and transcribed. A note taker also was present to observe body language and participant interactions. Following each focus group, participants completed a brief demographic questionnaire. Institutional Review Board approval was received at Georgetown University.

Data collection and design

Facilitators used a semi-structured topic guide—with required questions and suggested probes. Focus groups were organized around three plausible clinical

scenarios (see Appendix) reflecting likely test characteristics based on published research and interviews with genetic researchers in the field. During the group introduction, participants were asked to discuss strategies used to address smoking cessation with patients. Then scenario 1 was presented and physicians ranked their likelihood of offering the test. The facilitators then elicited reasons for and against offering the test. The next two scenarios were presented and, again, arguments for and concerns about the genetic test were discussed. These scenarios were presented sequentially to assess physicians' willingness to offer their patients a genetic test to tailor smoking treatment. The first scenario depicted a patient who would like to quit smoking, had tried previously and failed, and had no other complicating medical conditions. The physicians were asked to report the likelihood that they would offer the patient the test. Each of the two subsequent scenarios added new, potentially controversial information. The second scenario revealed that the same genotypes have pleiotropic associations not only with an increased risk of nicotine addiction but also with a greater risk of developing dependence on alcohol or other drugs such as cocaine, as well as various behavioral traits. The third scenario provided additional information that the genotype in question had been found to be significantly more prevalent among self-identified African Americans relative to Whites. Each of the "additional facts" presented in the second and third scenarios were based on published data (Billet et al., 1998; Comings et al., 1991; Comings et al., 1997; Comings et al., 1994; Comings et al., 1996; Lerman et al., 1999; Muglia et al., 2000; Rowe et al., 1998; P. G. Shields et al., 1998).

Physicians were given a printed version of each scenario and, following each scenario, were asked to rank (from 1="very unlikely" to 5="very likely") the likelihood that they would offer the genetic test. Physicians recorded their scores individually and then reported their scores to the group. After the scores were shared with the group, physicians discussed the perceived benefits and concerns associated with genetic testing in the context of tailoring smoking cessation treatment.

Data analyses

All focus group sessions were audiotaped and transcribed, and the moderator later reviewed the transcripts for accuracy. Three members of the research team coded all data independently, and data were analyzed using thematic content analysis. At each analysis phase, the three coders compared their results and resolved discrepancies. Themes within each content area were identified, and responses were categorized into codes. The reviewers then refined their definitions and the content of the codes and compared their coding lists. In each category, statements characteristic of the sentiment of the group were highlighted. The quotes illustrate sentiments expressed by many different physicians, across the four focus groups. An expert review of the coding scheme and results also was conducted, after the analyses were completed.

Results

A total of 27 physicians, including 16 men and 11 women, participated in four focus groups (Table 1). A majority of participants self-reported race as White (66.7%); four Asian/Pacific Islanders, three African Americans, one Hispanic, and one Middle Easterner also took part in the focus groups. Ages ranged from 29 to 57, with a mean age of 36 years. The majority of participants (n=19, 75%) spent more than 70% of their time delivering patient care, and 11 worked in an academic medical center.

Background attitudes about smoking cessation treatment and current practices

Physicians were first asked their impressions about the effectiveness of current smoking cessation treatments. Overall, there was a sense of frustration and discouragement as physicians reported having

Table 1. Characteristics of the study sample (N=27).

Characteristic	Number of subjects
Age (years)	
29–35	11
36–45	7
46–57	9
Gender	
Female	11
Male	16
Race/ethnicity	
White	18
Asian/Pacific Islander	4
Black, non-Hispanic	3
Hispanic	1
Middle Eastern	1
Years since medical school graduation[a]	
Within 5 years	9
6–10 years	4
11–20 years	7
21–26 years	6
Missing	1
Percentage of time spent in patient care	
30–60	6
70–90	11
95–100	8
Missing	2
Number of patients seen per week	
20–40	6
50	6
60–80	8
85–200	5
Missing	2

Note. [a]Assuming data collected in 2000.

minimal treatment success. Physicians agreed that motivation had to come from the patient for treatment to be effective and that patient preference was a powerful determinant in their pharmacological treatment recommendations and treatment outcomes. If patients demonstrated sincere motivation to quit, physicians expressed their willingness to try anything possible to help them succeed.

Benefits of genetic testing to tailor smoking treatment

Physicians identified many potential benefits of using genetic testing to tailor smoking treatment. Overall, physicians perceived benefits in destigmatizing addiction, selecting and directing individual treatment, increasing motivation, and enhancing prevention strategies. Specific benefits to the patient and to clinical practice were articulated, as noted below.

Patient-centered benefits. Physicians felt the greatest benefit associated with genetic testing to tailor treatment was the ability to better direct treatment for patients, therefore, increasing their probability of and motivation for quitting.

> I think letting someone know this is earmarked to them and their uniqueness probably will have a better chance of breaking the cycle of failure. Again, it adds something extra, whether it be placebo-like or whatever, encouragement.

Physicians believed the test would be a beneficial option for patients who had exhausted other treatments and repeatedly failed to quit.

> If she's had multiple quit attempts before, then I would be highly more likely to want to get a test that helped me figure out what was the right treatment.

In framing smoking as a disease, the test may relieve patients of personal blame and feeling that they are at fault for their inability to quit smoking, the burden of which may decrease chances of success.

> If you've got somebody who you try to legitimize the problem with, you could suggest that there's an organic basis, not just a psychological weakness or lousy habit … that there's some other basis for her addiction.

Many physicians also saw potential in using the genetic test as a preventive tool with non-smoking patients or early initiators, reasoning that awareness of elevated susceptibility to nicotine addiction might dissuade patients from initiating or continuing to smoke.

> And test patients who aren't smoking … this part that says the genotypes are associated with a greater likelihood of becoming addicted to nicotine in the first place, maybe I can do something with that information to motivate folks not to begin smoking.

Practice-based benefits. Physicians were hopeful that the test would provide new, cost-effective treatment by matching patients immediately to the most effective treatment. The fact that test results would be obtained quickly also appealed to physicians.

Barriers to physician adoption

Physicians discussed several barriers to adoption of a new genetic test to tailor smoking treatment. The concerns that physicians articulated could be described by three types of barriers: concerns related to the patient, concerns related to one's practice, and additional external factors.

Scenario 1: Baseline scenario

As seen in Figure 1, in response to the first scenario, 58% of the physicians responded that they would be likely or very likely to recommend genetic testing to tailor smoking treatment.

Patient-centered barriers. Many physicians questioned the benefits of immediate treatment matching based on genetic test results relative to merely cycling through available treatments according to patient preference. Moreover, some physicians expressed concern that practitioners would rely on the genetic test rather than take a comprehensive history of the patient.

> I wonder if a lot of this could be obtained by talking or getting a history as opposed to going after a gene … So I think we probably could get a lot of information clinically without ordering a test.

Physicians voiced significant concern that overemphasizing the biological factors associated with nicotine dependence would undermine the importance of psychological and behavioral determinants of both smoking and quitting.

> Just doing the test focuses on the test and not the patient himself. The patient is the key part of it. Eventually they are going to have to stop whether or not they are positive or negative for this gene.

Physicians also appreciated the difficulty of understanding the meaning of association studies and

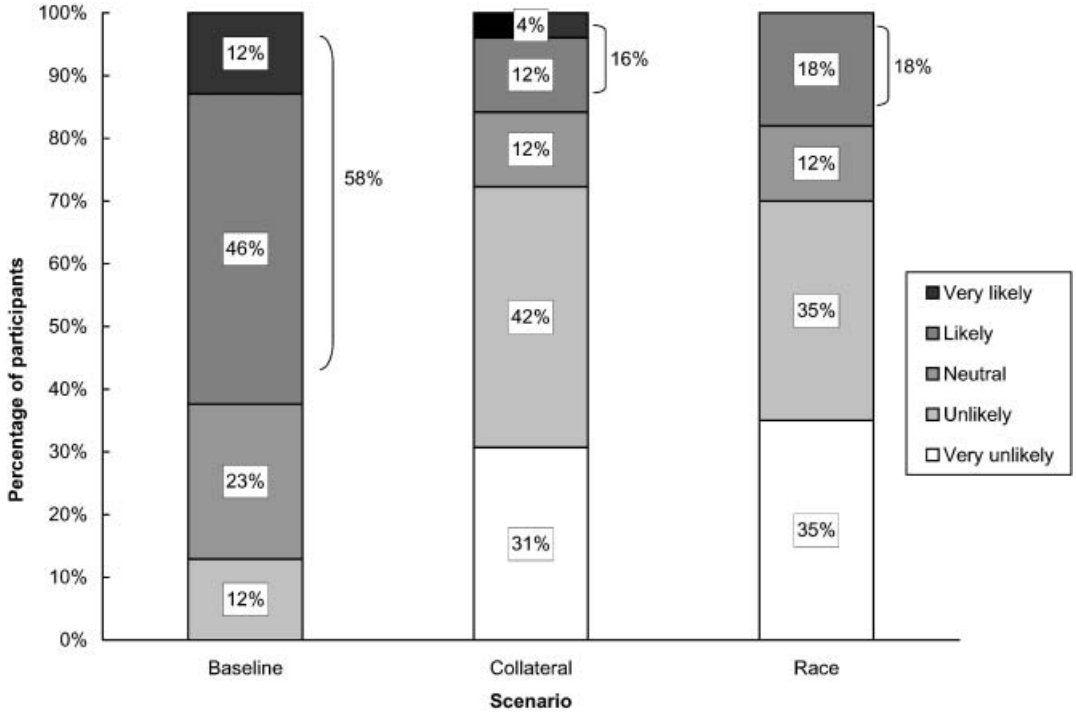

Figure 1. Likelihood of recommending genetic testing by scenario.

concepts of penetrance. They were concerned that patients could use a positive test result as rationalization for giving up trying to quit smoking.

> She might not be motivated to stop, because she might say, "Oh, it's in my genes, I'm predisposed to it. None of this is going to work."

Conversely, they worried that patients not genotypically inclined to a certain treatment might be discouraged from trying any smoking cessation treatments at all.

> If she doesn't have this genotype, then she could think, "Well, that's going to work for those people, but it's not going to work for me."

Practice-based concerns. Physicians expressed concern that integrating genetic testing into their practice would add to their already restricted time constraints, and that the test might provoke patient anxiety, leading to patient requests for additional genetic tests that might not be appropriate. Many physicians would be dissuaded from recommending the test if they could not get immediate test results or provide the test at their own office.

> It puts more burden on me to have to get the test results and make a phone call.

External factors of concern. Physicians were very apprehensive that patients who tested positive for the genetic test might have difficulty obtaining health insurance, face employment discrimination, and experience stigma. Physicians feared that health insurance companies would mandate that patients take the test and then raise premiums, deny or create obstacles to coverage, or terminate coverage for those patients identified as having a genotype associated with increased risk of addiction.

> Her insurance could say, "Oh, here's a smoker who's got a genetic predisposition, and she's failed treatment, so raise her rates, or drop her."

In addition to their qualms about insurance, physicians were very apprehensive about telemarketers or cigarette companies exploiting the information to identify consumers who might be more vulnerable to cigarette marketing.

> It is the beginning of genetic profiling. We talk about racial profiling. This is a very, very serious issue.

> The cigarette industry can get real cruel at times … Could they use and get a hold of this information to look at trends and patterns and then market and target [based on genotype]?

Scenario 2: Reveals pleiotropic associations

Following scenario 2, only 16% of participants responded that they would be likely or very likely to recommend the test. Physicians' concerns regarding the implications of a positive test result heightened dramatically.

Patient-centered barriers. In addition to their concerns raised in scenario 1 about patients losing motivation to quit, physicians worried in particular about patients' response to positive status for genotypes associated with increased risk of addiction to substances such as nicotine, alcohol, and cocaine, fearing that they may become fatalistic or demoralized.

> This is, "The devil made me do it … I'm genetically programmed…"

Also, physicians were apprehensive about the repercussions of a positive test result, fearing that children and teenagers who undergo testing might be labeled, feel stigmatized, or develop fatalistic perceptions.

> I don't know if they [teenagers] could process this information appropriately, if they could put it into perspective. They are dealing with enough issues let alone saying, "Gee, son, the chances of you becoming a coke addict are 30 percent higher than the national average."

Practice-based concerns. Many physicians were unclear about the meaning of genetic test results, how such information should direct clinical care, and their ability to effectively communicate genetic information to patients.

> It isn't concrete. You are doing a test that is saying that you may be predisposed to this; you might have an increased likelihood. What are you going to treat? I don't know what you are going to do with this information.

Prior to clinical integration, physicians agreed that they would need more information about the test, such as its sensitivity and specificity. Only a select few physicians demonstrated a clear understanding of the meaning of association studies. Finally, some were concerned that a time-consuming informed consent process would be needed.

External factors of concern. Once pleiotropic associations were brought into the discussion, physicians expressed elevated concerns about confidentiality and the potential for genetic discrimination. As with scenario 1, they anticipated insurance struggles for patients who tested positive for genotypes associated with increased risk of addiction. Physicians felt that the test might limit patients' rights and worried about employers possibly requiring testing of prospective employees. The effect of genetic status on policy decisions regarding who was a "good bet" to treat also emerged as a concern.

> Would the government-sponsored halfway houses for drug addicts—would they require you to take this test if they find that you are genetically inclined to drug use would they go ahead and spend their resources to treat you realizing that your relapse rate is so much higher?

Scenario 3: Reveals racial differences in risk alleles

Following scenario 3, 18% of participants responded that they would be likely or very likely to recommend the test. Several of the participants left before discussion of this scenario was completed.

Patient-centered barriers. Physicians were concerned that patients do not know how to interpret genetic information in general and that reported racial differences in the prevalence of certain genotypes across racial groups would compound the problem.

> I think there is this sense in the public of genetic testing being absolute, without a good understanding … a genotype has a 55 percent prevalence [in one group] … what does this really mean?

Practice-based concerns. The additional associations with risk of addiction and race exacerbated many physicians' concerns about their responsibility to ensure that any information generated by a test they recommended for their patients would not be used in a harmful manner to patients.

> What does this mean for us [as physicians]? … And it has to do not only with linking behaviors or diseases with genes, or as you said, what is the penetrance of these? How many of them get expressed, is there any way to predict which patients will express this particular gene? And if they do, what are … how do we manage it? What are the drugs, what are the strategies we use to tackle this? And ethically speaking, do we really want to know?

Other physicians did not feel that a 10% difference in the prevalence of genotypes between racial groups posed a particular problem; rather, the association with addiction was the most powerful barrier to integrating pharmacogenetic treatment for smoking into clinical practice.

> To me, [the identification of a genotype associated with addiction] is very inflammatory whether you're Caucasian or not, African American or not.

External factors of concern. Physicians echoed their previously expressed concerns regarding the potential for genetic discrimination with the addition of information about allele frequencies across racial groups.

> I would do the test and give the patient the information and throw it out.

Physicians were also very worried that racial differences in risk alleles would affect African Americans as a group, resulting in higher insurance premiums based on race.

> I think with labeling and insurance companies, this is like hitting (African Americans) with a smoking gun.

Some physicians felt that information about racial differences in the frequency of particular alleles associated with addiction was socially explosive information, with one participant saying it raised the specter of eugenics and social engineering. Physicians also worried that information about group differences in the prevalence of alleles associated with addiction might affect policy decisions regarding which social services are provided to different racial/ethnic groups, with the possibility that some might misinterpret this information.

> No matter what we do, it's not going to make a difference because there's a predisposition so they'll remove services from certain areas …
>
> When does it become racial profiling …?

Discussion

Genetically tailored tobacco dependence treatment may significantly improve smoking treatment outcomes. Physicians viewed patient motivation as the strongest predictor of successful smoking cessation and believed the possibility of tailoring treatment approaches to patients' individual characteristics might greatly enhance patient motivation. However, A. E. Shields and colleagues (2005) found that merely using the word *genetic* to describe a new test to tailor smoking cessation treatment was a barrier to the adoption of this test by primary care physicians, and the present study illustrated these barriers. Therefore, despite the expectation of an increasing role of primary care physicians in providing genetic services (Collins, 1997; Emery & Hayflick, 2001; Harris & Harris, 1995), our findings indicate that the complex issues involved in genetic testing to tailor tobacco dependence treatment greatly heighten physicians' concerns and thus pose a significant barrier to future clinical integration.

When presented with the first scenario, more than half of the physicians in the present study reported that they were likely or very likely to offer the genetic test to their patients. A sharp decrease in physicians' self-reported likelihood of offering a new test to tailor smoking treatment to their patients, as well as quite negative responses, were voiced when the addition of controversial information associated with the alleles was presented. Following presentation of the second scenario, physicians tended to focus more on the obstacles to the genetic test. The addition of the third scenario did not appear to further depress physician willingness but did raise additional concerns.

Current barriers to primary care physicians delivering smoking cessation counseling include lack of familiarity with guidelines regarding prescribing pharmacological treatment, insufficient counseling skills, and a lack of confidence in their ability to help patients stop smoking (Park et al., 2001). These barriers compounded with those demonstrated in the present study do not inspire optimism regarding the incorporation of pharmacogenetic treatment strategies into clinical practice at primary care settings. Our findings regarding knowledge of genetics is consistent with previous studies that have documented a lack of knowledge about genetic testing (Emery & Hayflick, 2001; Fetters, Doukas, & Phan, 1999; Stratakis, Cavuto, Nelson, & Rennert, 1995; Watson, Shickle, Qureshi, Emery, & Austoker, 1999) and show that physicians have difficulty interpreting test results and following guidelines and standards for genetic testing already in place (Demmer et al., 2000; Emery & Hayflick, 2001; Menasha et al., 2000).

Primary care physicians' limited ability to counsel patients about the results of genetic tests greatly increases the potential for genetic testing to result in misunderstanding and social harm. The fact that the same genotypes implicated in smoking behavior have been associated with cocaine and alcohol addiction (Comings et al., 1997; Comings et al., 1994) increases the potential for such harm. Ensuring that physicians have adequate knowledge and resources to provide

appropriate genetic services will go a long way toward minimizing potential harm to patients. To keep physicians up-to-date with the latest information related to genetics, we must use the information sources that physicians already rely upon on a daily basis. Although some physicians in the present study reported reading the standard medical journals for information, many depended on public sources, conferences, and often looked to colleagues who specialize in genetics to provide guidance in the area. Thus, including sessions on the most current genetic information at primary care conferences may be one way to increase physicians' knowledge and comfort with genetics.

Many of the physicians in this study expressed concern that genetic information may ultimately undermine treatment strategies if social and behavioral aspects of smoking are ignored. As pharmacogenetics provides new opportunities to tailor NRT by genotype, physicians must be introduced to these innovations as complements, rather than alternatives, to behavioral strategies. Providing clear clinical guidelines on how and when to use genetic testing in the context of smoking treatment could help ensure that clinical integration occurs safely and effectively. Future work is needed to better understand how patients will interpret genetic test results and how knowledge of one's genetic status is likely to affect patient attitudes and behaviors.

This study has several limitations. First, the focus groups consisted of a small convenience sample of physicians. This nonrandom selection of participants may have introduced an attitudinal bias within one or more of the groups. In particular, these physicians were all recruited from academic medical centers; therefore, the opinions of physicians from nonacademic medical centers were not assessed. However, physicians from nonacademic medical centers, who do not have the same access to recent research, might have even greater difficulties with clinical integration of genetic tailoring of nicotine dependence treatment. Another limitation of this study was that several of the participants left before their focus group discussions were completed and thus were not present to respond to the third scenario.

Although physicians welcomed additional tobacco treatment methods and identified many benefits to adopting the genetic test to tailor smoking cessation treatment, they expressed numerous barriers, especially when the complex issues involved with such a test were brought into the discussion. Physicians were particularly concerned about their lack of knowledge and confidence in communicating information about genetics to their patients, yet they reported a dearth of resources available to assist them. It is essential that concerns raised in this study, particularly lack of knowledge about clinical genetics, be addressed if the potential benefits of genetic research on tobacco dependence treatment are to be realized.

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Appendix: Scenarios presented to focus group participants

Scenario 1

A 35-year-old African American female, Mrs. Jones, comes in for an annual check-up. She has been smoking 1 pack of cigarettes a day for 7 years. She has insurance. In the course of the exam, Mrs. Jones tells you that she wants to quit smoking.

A new genetic test has come on the market for matching patients to NRT by genotype. Research has suggested that individuals with particular genotypes for dopamine-related genes have a 30% higher quit rate after 1 year if prescribed nasal spray rather than the nicotine patch. These same genotypes have been associated with a greater likelihood of becoming addicted to nicotine in the first place. These results have been published in peer-reviewed journals and replicated in other studies. The cost of the test is comparable to that of a Chem7 and has the same turn-around time for test results. This test is covered by her insurance with no copay.

Scenario 2

These same genotypes are associated with a predisposition to dependence on alcohol, other drugs, such as cocaine, and other behavioral traits (e.g., thrill-seeking behavior). So, this same test that you would use to match the patient to the best nicotine replacement therapy ends up generating information more akin to a genetic behavioral profile.

Scenario 3

Studies have also shown that this genotype has a prevalence rate of 55% in African Americans relative to a prevalence rate of 45% among Caucasians, a statistically significant difference.