Primary care physicians' concerns about offering a genetic test to tailor smoking cessation treatment

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Purpose: We assessed the importance assigned by primary care physicians to eight factors influencing whether they would order a genetic test to individually tailor smoking cessation treatment. **Methods:** A random sample of United States primary care physicians was surveyed about how important each of eight factors were in the decision to order the test. Broadly, these factors included the ability of the test to improve treatment, the patient's reaction to test results, concern about misuse of test results, and the ability of the physician's office to manage informed consent for the test. **Results:** Physicians indicated the most important factor they would consider in ordering a genetic test to tailor smoking cessation treatment was the ability to improve cessation outcomes. However, when told the genotype identified by the test was associated with stigma-inducing mental health conditions, physicians emphasized the importance of possible racial, insurance, and employment discrimination in their decisions. **Conclusions:** Primary care physicians are eager to improve smoking cessation treatment, but the collateral information generated by genetic testing to tailor treatment may be an impediment unless proper antidiscrimination measures are in place. *Genet Med* 2007:9(12):842–849.

Key Words: *smoking, smoking cessation, addiction, primary care, legal protections*

Genetic testing has the potential to revolutionize modern medicine. Hundreds of genetic tests are already commercially available, and an even greater number are being developed.[1] Advances in genetic science carry the promise of improved care through greater accuracy in disease screening,[2] improved guidance for preventive care,[3,4] and individually tailored treatment options.[5–8]

One area of genetic research of particular importance to public health policy is the development of genetic tests to more effectively target smoking cessation medications. Smoking is the leading preventable cause of premature death in the United States.[9,10] More than 20% of adults in the United States were smokers in 2004.[11] Each year, 70% of smokers express an interest in quitting and there are a variety of treatments, including pharmaceuticals, that are available to assist smokers in quitting.[12–15] However, relapse rates are high even with the best treatments. Twin studies have identified the heritability of smoking to range between 50 and 70%,[16–19] leading to numerous studies aimed at understanding the role of specific genetic variants in nicotine addiction and response to smoking cessation treatment. Recently published studies and ongoing clinical trials suggest that genetically tailored smoking cessation treatments may become one of the first broad applications of pharmacogenetics for a highly prevalent complex trait.[20–33]

Genetic testing, however, does not come without possible risks. Patients are concerned about the potentially harmful consequences of undergoing genetic testing, particularly the potential for genetic discrimination. Surveys have indicated patients are worried about discrimination by health, life, and long-term care insurers, and employers.[34–37] In the case of genetically tailored smoking cessation treatment, these issues are made particularly salient by the fact that many genetic variants that are associated with smoking behavior are also associated with alcohol and cocaine addiction,[38–41] attention deficit hyperactivity disorder, Tourette syndrome, and a number of other psychiatric conditions.[39,42,43] It has been suggested that reluctance to undergo genetic testing for fear of discrimination may have its greatest impact on low income patients who do not want to submit claims for genetic testing to an insurance company and cannot afford to pay for the test themselves.[44]

Primary care physicians (PCPs) share many of these same concerns. Genetic discrimination, confidentiality, problematic family issues, and patient confusion regarding the meaning of genetic test results are among physicians' concerns with genetic testing.[45–48] Doctors are also apprehensive about the inadequacy of their individual knowledge and understanding of new genetic tests, and their ability to accurately recommend such tests to patients, with only 4% of physicians nationally reporting that they feel prepared to counsel patients considering a genetic test.[49]

Physicians already have a clear role in promoting smoking cessation to their patients,[50] which is reinforced by health care

quality measurement efforts.[51] It is almost certain that the greatest burden for recommending any future genetic test to tailor smoking cessation treatment will fall to PCPs.[52–59] Thus, it is important to better understand the influences and factors that inform PCPs' decisions to recommend these tests. Although there have been studies examining physicians' attitudes toward genetic testing for cancer susceptibility,[46,58,60] where several pharmacogenetic tests are now widely used, few studies have surveyed physicians' attitudes toward non–cancer-based genetic tests. Understanding physicians' concerns before widespread dissemination of a novel pharmacogenetic test may allow for more effective, targeted education and guidance when new tests become available, thereby avoiding many unintended consequences associated with clinical integration. In this study, we surveyed a random sample of PCPs to determine the relative importance of eight potential concerns facing physicians considering whether to order a new genetic test to tailor smoking cessation treatment. We assessed the relationship between physicians' ratings of the importance of each of these eight factors and a set of test, physician, and practice characteristics.

MATERIALS AND METHODS

Survey overview

The physician survey was designed to gather information about PCPs' training and experience with clinical genetics and their attitudes and concerns regarding the potential use of genetic testing to tailor smoking cessation treatment. Eight factors affecting physicians' willingness to offer a new genetic test to tailor smoking cessation treatment were identified and refined through physician focus groups and were included in the survey. Full details of survey development are available elsewhere.[49] Using the AMA Masterfile as the sampling frame, we mailed surveys to a random sample of 2000 PCPs. Data collection was conducted over a 7-month period, and was completed in November, 2002. The survey protocol was approved by the institutional review board of Georgetown University (where the senior author was on faculty at the time of the survey). Given our interest in surveying the attitudes of PCPs engaged primarily in clinical practice, respondents were ineligible for inclusion in the study if they practiced direct patient care fewer than 20 hours per week. The final response rate adjusted for ineligible cases was 62.3% ($n = 1120$). Members of the sample of 1120 were somewhat less likely to be younger physicians (age 27–44) and women compared with national estimates. Respondents were randomized to one of two survey instruments, which presented a new test to tailor smoking cessation treatment as a genetic or a nongenetic test. Our analysis focused on the 562 respondents who were assigned the genetic version of the survey.

Survey scenarios

The survey asked physicians to rate the likelihood that they would offer patients a new genetic test to tailor smoking cessation treatment under four successive scenarios, each of which

described likely characteristics of such a test based on published scientific literature. The baseline scenario described a test that, to the respondents' satisfaction, indicated individuals testing positive for a specific genotype would have "a clinically meaningfully improvement in quit rate" using nicotine nasal spray over the nicotine patch. Physicians were asked to consider whether they would offer such a test to a 35-year-old African American woman who smokes a pack of cigarettes per day, wants to quit, has no contraindications for nicotine replacement therapy, and whose insurance will cover the genetic test. Next, physicians were asked to consider their likelihood of offering the test with the additional information that the genetic variant being assessed is also associated with an increased risk of nicotine addiction itself (Nicotine Scenario). The third scenario added to the first two the fact that the genetic variant is slightly more prevalent (53% vs. 43%) among African Americans than it is among whites (Race Scenario). The last scenario added the fact that the genetic variant identified by the test is also associated with an increased risk of alcohol and cocaine addiction, and a number of other conditions such as attention deficit hyperactivity disorder and Tourette syndrome (Pleiotropy Scenario).

Main outcome measures

After each scenario was presented, respondents were asked to indicate how likely they were to offer such a genetic test on a scale of 0–100%. In the latter three scenarios, respondents were also asked to rate how important (1 = "not at all important" to 5 = "very important") each of the eight factors was in making the decision to order the test or not (Table 1). Very broadly, these eight factors cover the ability of the test to improve treatment, the patient's reaction to the test information,

Table 1
Factors affecting decision to recommend new genetic test

A. The opportunity to find a treatment option that is matched to your patient's individual characteristics

B. The possibility that, if your patient tests *positive* for this particular genotype, she might be *encouraged* by having a more tailored treatment option

C. The possibility that, if your patient tests *positive* for this particular genotype, she might be *discouraged* by knowing this additional information about herself

D. The possibility that, if your patient tests *positive* for this particular genotype, she might be stigmatized or face greater discrimination based on the test results

E. The possibility that, if your patient tests *negative* for this particular genotype, she might believe that she can smoke without becoming addicted

F. The possibility that if your patient tests *positive* for this particular genotype, health insurers might limit or deny her coverage, or increase her premiums

G. The possibility that, if your patient tests *positive* for this particular genotype, employers might limit her employment opportunities

H. The resources your office/clinic has to address informed consent for such a test

concern about possible misuse of the information provided by the test, and the ability of the physician's office to address issues involving informed consent for the test. Our focus in the present study is assessing the relative importance of each of these factors to PCPs' anticipated likelihood of offering a new genetic test to individually tailor smoking cessation treatment.

Additional survey data

Respondents were asked to provide a variety of information describing themselves and their practices. Demographic information included physicians' age, sex, race (white, black, other), and ethnicity (Hispanic or not). Respondents indicated whether or not they had ever smoked cigarettes. Regarding medical training, respondents were asked the year they graduated medical school (coded < 10 years ago or ≥ 10 years ago) and whether they had had any training in clinical genetics through formal courses, clinical rotations during medical school or residency, or continuing medical education. Physicians' specialties (general medicine, internal medicine, or family practice) were gathered from the AMA Masterfile. Physicians were asked if they had a full-time faculty appointment at a medical school and whether their medical practices were independent or affiliated with another entity, for example an inpatient facility, a clinic, or a health maintenance organization. Respondents were asked the proportion of their patients that were uninsured, enrolled in Medicaid, from a racial/ethnic minority community, or spoke a primary language other than English. In our analyses, these measures were dichotomized to top quintile versus the bottom four. For example, the 20% of respondents whose practices had the highest proportion of uninsured patients were compared with the 80% of respondents whose practices had lower proportions of uninsured patients.

Physicians were also asked their opinions and practices on several medical topics, including how often they recommend/prescribe medication for smoking cessation (always/often versus sometimes/rarely), how often they refer patients for smoking cessation treatment (always/often versus sometimes/rarely), what percentage of interindividual variation smoking behavior is attributable to genetics (≤50% vs. >50%), whether they tended to adopt new diagnostics before their peers, their level of optimism that genetics research will improve treatment of complex traits such as smoking behavior, and how prepared they feel to counsel patients regarding genetic testing. Physicians were asked two questions about federal law prohibiting genetic discrimination in health insurance based on the Health Insurance Portability and Accountability Act[61]: "Under current federal law, can health insurance companies use genetic test results to increase patients' health insurance premiums or deny patients health insurance coverage: (1) in the group health insurance market; (2) in the individual health insurance market?" Two correct answers (no and yes, respectively) were considered correct knowledge of federal privacy laws.

Statistical analyses

Our primary goal was to understand how test characteristics, physician characteristics, and practice characteristics affect the importance ascribed to each of the eight factors in determining physicians' willingness to adopt a new test to tailor smoking cessation treatment. To facilitate interpretation of our findings, we dichotomized the importance of each factor as important/very important (response is 4 or 5) or less than important (response is 1, 2, or 3). Separate regressions were run for each of the eight factors with this dichotomized variable (1 = factor deemed important or very important) as the dependent variable. Each of the eight factors was measured three times, once for each of the nonbaseline scenarios. We assumed no interaction between scenario and other independent variables. Therefore, we treated responses across each scenario as repeated measures of a physician's beliefs about the importance of each of the eight factors and modeled them using generalized estimating equations to account for correlation in responses across the three scenarios. The generalized estimating equations models used a logit link, binomial distribution, and unstructured correlation. Indicators for the scenarios were included in the models to determine how providing additional information about the genetic test affected the perceived importance of each factor. Multivariate models control for the additional population characteristics described above. Covariates were chosen based on findings from earlier analyses of these data.[49] We chose to include the same covariates in each model to ensure the comparability of our findings across outcome variables. Each model included only those respondents for whom we had complete data on independent variables (473 of 562, or 84% of respondents). There were fewer than 5% missing data for any variable. All analyses were adjusted using weights created to match the distribution of physician specialties in the sample with the distribution in the AMA Masterfile.

RESULTS

Study population

Characteristics of our study population are presented in Table 2. About one fifth of the respondents were women, more than half were between 45 and 64 years old, and over 60% were in independent practice. Fewer than a quarter believed that individual variation in smoking behavior is determined by at least 50% genetic factors. Three-quarters of the respondents had received formal training in clinical genetics. About 14% of the respondents indicated they were very optimistic about the ability of genetic testing to improve treatment of conditions with complex traits. Only 5% were confident in their ability to interpret the results of a genetic test. Just under 10% had an accurate understanding of current federal law regarding the use of genetic information to determine health insurance coverage.

Unadjusted importance of factors

We present unadjusted analyses of the importance each factor played in physicians' decisions regarding whether or not to offer the genetic test under each test scenario in Figure 1. The ability to tailor smoking cessation treatment (A) and the possibility of having the patient encouraged by the test results (B)

Table 2
Characteristics of the study population (N = 562)

Characteristic	Percent
Race/ethnicity	
White, non-Hispanic	73.8
Black, non-Hispanic	2.6
Hispanic	3.7
Other race	20.0
Gender	
Female	20.1
Age	
≤44	34.7
45–64	53.8
≥65	11.5
Year of graduation from medical school 1990 or later (versus before 1990)	8.6
Percent with full time faculty appointment	10.0
Percent current or former smoker	22.1
Training in clinical genetics (% yes)	75.7
Smoking cessation treatment practices	
Often/always prescribes pharmacological treatment (bupropion, nicotine patch, nicotine gum) to patients who wish to quit smoking	83.4
Often/always refers patients for smoking cessation treatment	28.0
Practice setting/type	
Independent practice (versus other)	61.3
Family or general practice (versus internal medicine)	46.8
Characteristics of physicians' patient panel	
High proportion uninsured	18.3
High proportion Medicaid	14.4
High proportion with primary language other than English	15.9
High proportion minority	14.0
Physician attitudes/beliefs regarding genetics	
Early adopter of new genetic tests	14.8
Very optimistic that genetics research will lead to significant clinical improvements	13.8
Believes 50% or more of variation in smoking is due to genetics	23.4
Accurate knowledge of current legal protections	9.5
Very prepared to counsel patients considering a genetic test	4.2
Very confident interpreting a genetic test result	5.3

were the factors with the highest average importance. Approximately 80% reported the factors were deemed important or very important, regardless of scenario. Very few physicians reported that the possibility the patient might be discouraged by additional information she received about herself (C) was important or very important, but the proportion indicating factor C was important increased in the Pleiotropy Scenario relative to the Nicotine and Race Scenarios. Factors D, F, and G all describe possible inappropriate use of the genetic test results. For each, the additional information in the Pleiotropy Scenario increased the proportion of physicians reporting the factor was important or very important.

Multivariate assessment of factors

The multivariate analyses (Table 3) indicate that physicians who are optimistic about genetics' ability to improve treatment of complex traits such as smoking behavior were more likely to consider the ability to tailor smoking cessation treatment (A) and encourage patients (B) important in their decision to order the test. Nevertheless, even while controlling for a range of physician and practice characteristics, knowledge of pleiotropic associations significantly increased the likelihood that physicians would consider possible inappropriate use of the test results important in determining how apt they would be to order a genetic test to tailor smoking cessation treatment. The adjusted odds that a physician would consider patients' difficulties with health insurance an important factor increased 60% in the Pleiotropy Scenario relative to the Nicotine Scenario. Physicians had more than twice the odds of considering racial stigmatization/discrimination and potential discrimination in employment important or very important factors in deciding whether to offer the new test under the Pleiotropy Scenario relative to the Nicotine Scenario.

Accurate knowledge of laws pertaining to the use of genetic test results approximately doubled the odds that physicians would consider possible denial of health insurance (F) or employment (G) important/very important in making the decision to order a genetic test or not. Physicians treating the highest proportion of Medicaid patients attributed higher importance than their counterparts serving fewer Medicaid patients to 6 out of 8 factors (A, B, E, F, G, and H) and female physicians attributed higher importance to 4 out of 8 factors (C, D, G, and H) than their male counterparts. Black physicians showed more than three times the odds of considering important/very important that with a negative test, the patient would believe that she could smoke without becoming addicted (E) and nearly three times the odds of considering a lack of office resources (H) to be important compared to white physicians. Hispanic physicians had more than twice the odds of non-Hispanic physicians of indicating stigma and discrimination stemming from the test (D) and having the patient believe she could smoke without becoming addicted (E) were important/very important.

Although our models controlled for beliefs and attitudes about genetic testing, it is possible that in doing so we controlled for highly collinear or intermediate factors. However, removing the attitudes and beliefs covariates did not substantially alter the magnitude or the statistical significance of our key findings.
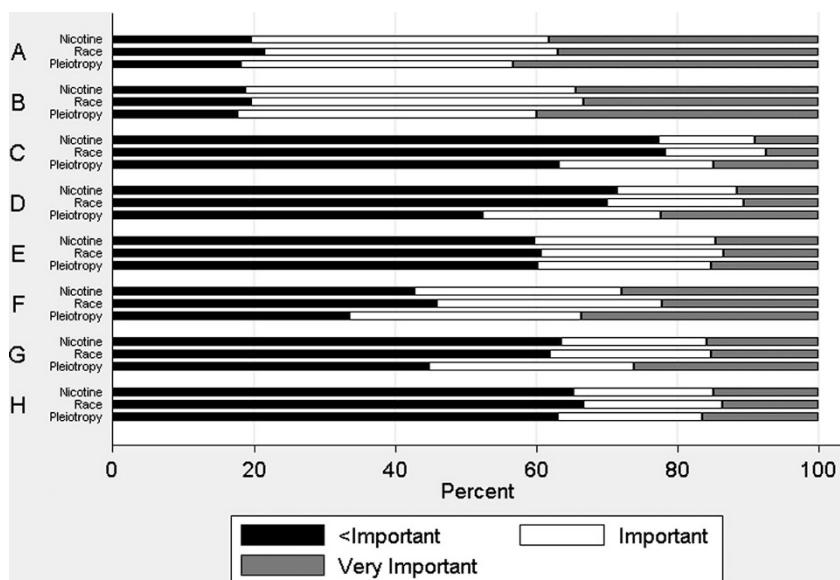
Fig. 1. Unadjusted responses to the importance of each factor by scenario. For a description of the scenarios A–H refer to Table 1.

DISCUSSION

We conducted a national survey of PCPs to investigate the relative importance of eight high priority factors in determining physicians' willingness to adopt a new test to tailor smoking cessation treatment. Our findings emphasize physicians' enthusiasm for more efficacious smoking cessation treatments. The ability to more precisely target smoking cessation treatment and to encourage patients with the knowledge that their treatment was tailored were the factors deemed most important to the decision of whether or not to offer the genetic test.

Nevertheless, the potential for information generated by the test to adversely affect the patient poses an important potential barrier to physicians' adoption of a new genetic test to individually tailor smoking cessation treatment. When physicians were informed that genotypes identified to tailor smoking cessation treatment would likely also have pleiotropic associations with other psychiatric conditions, including alcohol and cocaine addiction, attention deficit hyperactivity disorder, and Tourette syndrome—-all associations published in the scientific literature—-physicians' concerns regarding the potential for genetic information to be misused by health insurers or employers, or to generate stigma, increased significantly in importance relative to the Nicotine scenario. Those physicians demonstrating accurate knowledge of how HIPAA regulations differentially protect consumers in the individual, small group, and large group insurance markets were more likely to consider potential misuse of genetic information by health insurers and employers an important factor in determining whether or not to offer the genetic test. Together these findings suggest that widespread adoption of pharmacogenetic smoking cessation treatment among PCPs will depend not only on the ability to more effectively target treatments, but also on adequate protection of patients' privacy.

According to the National Council of State Legislators, nearly all states had laws prohibiting the use of genetic information to establish eligibility for health insurance or for risk adjustment/selection purposes by 2005.[62] In addition, 34 states have laws prohibiting genetic discrimination in employment.[63] However, the specific protections afforded by these statutes vary considerably from state to state. Our findings suggest that nominal legislative protections will be insufficient to alleviate some physicians' concerns about patient privacy. There will be a greater chance of widespread clinical adoption of genetically tailored smoking cessation treatment with unambiguous, comprehensive legal protections in place for genetic privacy. As of this writing, the US House of Representatives has passed the Genetic Information Nondiscrimination Act, a bill that will prohibit denial of employment or health insurance based on genetic information and will prohibit health insurance premiums from taking genetic information into account. Such legislation, should it be enacted, may mitigate this important barrier to genetic testing.

Another critical issue impacting the use of pharmacogenetic treatments for addiction and other complex conditions is the general misinterpretation of genetic information. Early breakthroughs in understanding the relationship between genes and disease were based on Mendelian traits where risk alleles are almost completely penetrant (i.e., if the genetic mutation is present, the trait will almost certainly develop, as in the case of Huntington disease). This sort of relationship has helped shape the public's[52] understanding of how genes more generally influence disease.[64] However, genetic risks for complex conditions are best characterized using a probabilistic interpretation of risk. For example, carriers of the Pro12Ala mutation of the $PPAR\gamma$ gene have only a 25% increase in the risk of type 2 diabetes.[65] It seems likely that genetic risk factors for most common mental health conditions, including addiction, will have a similarly muted effect, with environmental, social, and behavioral factors playing important roles in disease incidence.

Table 3
Results of GEE models assessing importance of factors as a function of scenario, physician characteristics, and practice characteristics

	A. Tailoring treatment N = 466	B. Encouraged by tailoring treatment N = 466	C. Discouraged by additional information N =465	D. Stigma/ discrimination N = 463	E. Believe can smoke without addiction N = 465	F. Insurance problems N = 463	G. Employment problems N = 464	H. Lack of office resources N = 465
Nicotine scenario	REF	REF	REF	REF	REF	REF	REF	REF
Race scenario	0.9 (0.8–1.1)	1.0 (0.8–1.2)	1.0 (0.9–1.3)	1.1 (0.9–1.3)	1.0 (0.9–1.1)	0.9 (0.8–1.0)	1.1 (1.0–1.3)	0.9 (0.8–1.1)
Pleiotropy scenario	1.1 (0.8–1.4)	1.1 (0.8–1.4)	2.3 (1.8–2.9)[a]	2.4 (1.9–2.9)[a]	1.0 (0.8–1.2)	1.6 (1.3–1.9)[a]	2.3 (1.9–2.8)[a]	1.1 (0.9–1.3)
Physician gender								
Male	REF	REF	REF	REF	REF	REF	REF	REF
Female	1.2 (0.7–2.1)	1.0 (0.6–1.7)	2.0 (1.3–3.0)[b]	2.2 (1.4–3.3)[a]	1.5 (1.0–2.3)[c]	1.5 (1.0–2.5)	1.6 (1.1–2.45)[c]	1.8 (1.1–2.9)[c]
Physician race								
White	REF	REF	REF	REF	REF	REF	REF	REF
Black	1.5 (0.3–8.2)	1.1 (0.2–6.6)	1.3 (0.5–3.6)	1.9 (0.8–4.6)	3.3 (1.5–7.1)[b]	1.9 (0.5–7.1)	2.0 (0.7–6.1)	2.9 (1.2–7.5)[c]
Other	0.9 (0.5–1.5)	1.5 (0.8–2.6)	1.0 (0.6–1.6)	0.8 (0.5–1.3)	1.4 (0.9–2.2)	1.5 (0.9–2.4)	1.2 (0.7–1.9)	2.3 (1.4–3.6)[a]
Physician ethnicity								
Hispanic	0.7 (0.25–1.90)	0.6 (0.3–1.3)	2.2 (0.8–5.6)	2.7 (1.1–6.5)[c]	2.5 (1.1–5.5)[c]	1.3 (0.5–3.6)	1.7 (0.6–4.3)	1.2 (0.5–3.1)
Non-Hispanic white	REF	REF	REF	REF	REF	REF	REF	REF
High proportion uninsured patients	0.4 (0.2–0.7)[a]	0.4 (0.2–0.6)[a]	1.1 (0.7–1.8)	1.0 (0.6–1.6)	1.0 (0.6–1.6)	1.0 (0.6–1.6)	1.1 (0.7–1.7)	1.3 (0.8–2.2)
High proportion Medicaid patients	2.7 (1.3–5.7)[b]	2.1 (1.0–4.4)[c]	1.1 (0.6–1.9)	1.0 (0.6–1.7)	1.8 (1.1–3.0)[c]	2.8 (1.6–5.1)[a]	2.6 (1.5–4.6)[a]	2.5 (1.5–4.4)[a]
High proportion patients with primary language other than English	0.7 (0.4–1.4)	1.1 (0.6–2.1)	0.8 (0.45–1.4)	1.0 (0.6–1.6)	1.4 (0.80–2.3)	0.7 (0.4–1.2)	1.2 (0.7–2.1)	0.8 (0.4–1.4)
High proportion minority patients	1.9 (0.9–3.9)	1.7 (0.8–3.5)	1.1 (0.6–1.9)	0.9 (0.6–1.6)	0.9 (0.50–1.6)	1.0 (0.6–1.8)	1.0 (0.5–1.7)	0.9 (0.5–1.7)
Accurate knowledge of current legal protections	1.1 (0.5–2.3)	1.1 (0.5–2.4)	1.1 (0.6–2.0)	1.5 (0.9–2.6)	1.15 (0.66–2.03)	1.9 (1.0–3.7)[c]	2.1 (1.2–3.8)[c]	1.0 (0.5–1.9)
Optimistic that genetics will improve treatment of complex traits	3.7 (1.6–8.6)[b]	2.3 (1.1–4.7)[c]	1.5 (0.8–2.5)	1.1 (0.7–1.8)	1.0 (0.6–1.6)	1.4 (0.8–2.4)	1.4 (0.8–2.5)	2.0 (1.2–3.5)[c]

All values indicate adjusted OR (95%CI).
Also included in model but not shown: physician age, smoking status, year of graduation from medical school, faculty appointment, training in clinical genetics, beliefs/attitudes regarding genetics, practice setting/type, and smoking cessation treatment practices (See Table 2).
[a]P < 0.001, [b]P < 0.01, [c]P < 0.05.

Nevertheless, it may be that physicians' concerns regarding the inappropriate use of genetic information, particularly in cases with socially significant pleiotropic associations, are based on their fears that insurers, employers, or other members of the public would interpret genetic information deterministically, or possibly on their own deterministic understandings of genetic risk. Thus, a positive test for the genotype described in our survey would also be construed as a positive test for high risk of alcohol or cocaine addiction among other problematic conditions.

Efforts are underway to improve clinical education in genetics by establishing "core competencies" in genetics for health care professionals.[66] If misinterpretation of genetic test results among PCPs is a problem, it is diminishing. Addressing misconceptions about the relationship between genetics and disease outside the realm of clinical care will not be so straightforward. It will take careful, consistent effort by knowledgeable clinicians, researchers, advocates, and members of the media to educate the public on the role genes play in complex conditions including nicotine addiction. Potential problems stemming from misinterpretation of genetic testing results is yet another argument for genetic nondiscrimination laws.

Our findings should be considered in light of certain limitations. For one, our study participants were asked to respond to a new genetic test whose arrival is anticipated but which is not yet available. Although evidence suggests that self-reported behavior by physicians closely corresponds with their actual practices,[67–69] this is less often the case for counseling on lifestyle or behavior changes.[70–72] We do not have data on how physicians would approach a real genetic test with actual patients. We also do not know how physicians' planned behavior corresponds to their way they ultimately behave in fact. In addition, our survey had a 62% response rate. Although this is not unusual for a study of physicians and we have adjusted our weights to reflect differences in the distribution of specialties between the survey sample and the population of PCPs, to the extent that members of our sample differ from PCPs overall, our findings may not be perfectly generalizable. Lastly, we report findings from a survey that is already several years old while the pace of genetics research has only accelerated. That said, our data reflect one of the most comprehensive assessments of PCPs' concerns about genetic testing that is available.

PCPs are eager to improve their ability to assist smokers who are interested in quitting. The use of genetic information to match patients with optimally effective treatments for nicotine addiction may become a promising strategy for reducing the damage done to our nation's health by smoking. However, the risk that collateral information generated in conjunction with genetic testing for complex conditions, such as addiction, could harm patients is an important issue for the PCPs who will bring pharmacogenetics into widespread clinical use. Adequate legal protections against genetic discrimination and effective education of providers regarding clinical genetics are essential to the achieving the promise of pharmacogenetics.

IRB approval

The Georgetown University Institutional Review Board provided the approval for this study. (Approval number 2002-025). Dr. Alexandra E. Shields was a faculty member at Georgetown University during the initiation of the study. Approval was gained for the national mail survey following standard IRB procedures.

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