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Lack of Interest by Nonpregnant Couples in Population-Based Cystic Fibrosis Carrier Screening

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Summary

We used signs and letters to offer free cystic fibrosis (CF) carrier screening to nonpregnant adults in stable relationships who visited numerous clinical and nonclinical sites in Nashville. A total of 179 individuals (≪1% of those eligible) elected to be tested. To understand this observation, we used questionnaires to assess individuals' attitudes about genetic testing in general and about CF carrier screening in particular ($n = 873$). Participants expressed conflicting views about carrier screening. More than 90% of people thought that genetic testing should at least be available. Most respondents said that the views of their partners and physicians were important in their decision making, and most believed that these others favored genetic testing. Yet, more than two-thirds indicated that such factors as insurability, being "at risk," what they would need to learn, abortion, and religious beliefs were important in their decision making, opinions that mitigated against genetic testing. In particular, one-third feared that carriers would lose their health insurance, one-quarter said that they would have been more interested had they been able to provide DNA by buccal swab rather than by finger stick, and less than one-sixth believed that genetic testing was meddling in God's plan. In the face of both the low level of use of free CF carrier screening by nonpregnant couples when it was not offered in person by health-care professionals and the wide variety of concerns demonstrated, we believe that clinicians should not routinely offer carrier screening to nonpregnant individuals who do not have a family history of CF.

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Introduction

When the gene for cystic fibrosis (CF) was discovered, companies quickly began to develop tests to detect carriers, with the expectation that such tests would be used by the general population, regardless of whether they had a family history of CF. Several reservations, however, were raised about the prospect of population-based carrier screening for CF. For some commentators, acting to avoid the birth of children with CF seemed an inappropriate goal, in part because of the improved prognosis of individuals affected with CF and in part because of the belief of some that a cure for this disease would be developed in the near future (Colten 1990; Screening for cystic fibrosis 1992; Beeson 1993; Sorenson et al. 1994). Others were concerned about the limitations of the test itself. Unlike carrier screening for Tay-Sachs and sickle-cell disease, which approach 100% sensitivity, early tests that sought only the ΔF508 mutation could detect only ~70% of CF carriers in populations of northern-European descent. Some wondered whether this level of sensitivity was sufficient to warrant devoting the resources needed for population-based screening (Gilbert 1990; Faden et al. 1994). Many were concerned about the uncertainty that would be faced by couples when only one partner was shown to be a carrier (Workshop on Population Screening for the Cystic Fibrosis Gene 1990; Wald 1991). Even when additional mutations are sought, the carrier-detection rate in CF population screening remains, at best, 85%–90% among those of northern-European origin and generally is lower in other populations (U.S Congress, Office of Technology Assessment 1992). The projected demand and the perceived difficulties of informing people about CF carrier screening, particularly about the possibility of false-negative test results, led some to calculate that genetics personnel would be overwhelmed by the introduction of CF carrier screening (Roberts 1990; Wilfond and Fost 1990, 1992).

These and other anticipated problems in developing acceptable programs for CF carrier screening led to a moratorium on the widespread adoption of screening (Caskey et al. 1990; Workshop on Population Screening

for the Cystic Fibrosis Gene 1990; Statement of The American Society of Human Genetics on cystic fibrosis carrier screening 1992). The National Institutes of Health then funded a series of pilot studies, of which ours was one, to determine how best to offer voluntary CF carrier screening. Responding to concerns that new genetic tests will overwhelm available personnel, we sought to determine whether written or video educational materials would provide people with adequate information to enable them to make informed decisions about CF carrier screening. To this end, signs and information sheets were placed both in health-care sites and in public sites, offering free CF carrier screening to nonpregnant couples and stating that information about the tests was available from the receptionists and clinic staff. Health-care personnel at these sites did not actively promote carrier screening and were asked to refer all participants' questions to study personnel. Under these conditions, very few people obtained testing. We used questionnaires to learn more about the demographic and attitudinal factors associated with this low observed level of interest. We conclude from our data and from reviewing the findings of others that individuals in the general population who are not currently pregnant (1) do not demonstrate widespread demand for free CF carrier screening when it is not offered in person by their health-care providers and (2) have conflicting views about the desirability of genetic testing.

Study Design

This paper reports the results of two related studies. In the first study (screening study), we offered free CF carrier screening and sought to compare the efficacy of written versus video materials in conveying factual information about CF and CF carrier screening to nonpregnant individuals in stable relationships. As part of this study, we also ascertained the participants' views about genetic testing. In the second study (attitude study), which we undertook to increase our understanding of the observations of the screening study, we focused solely on assessing the attitudes that adults of reproductive age have toward genetic testing.

Screening Study

To determine whether it is possible to educate people about CF carrier screening without face to face counseling, we offered screening in the following way. Signs offering free carrier screening for CF were placed in the check-in windows of numerous pediatric and obstetric clinics and offices and in a variety of public sites in Nashville. Letters describing the study were placed in a pocket on the signs and included a short description of CF; the criteria for entry into the study (participants had to identify themselves as being $\geq$18 years of age, not pregnant, and in a steady relationship); the fact that CF carrier screening costs ~$200 per couple but was being offered free to couples in this study; and the study design, which included randomization to either written or video materials that described CF and carrier screening. The letter made clear that individuals could review the educational materials and answer the first questionnaire without their partners and without making a commitment to proceed with CF carrier screening. At most sites, people were offered a free book about child care if they participated in this phase of the study. Any individual who was interested in participating in this study after reading the letter was directed to speak with the clinic's or practice's receptionist, who then provided the person with either written or video educational materials (the written materials are reproduced in full by Clayton et al. [1995]) according to the randomization schedule and a packet that contained (1) a consent form in which the person agreed to review the educational materials and to respond to a questionnaire; (2) the questionnaire; and (3) a consent form to obtain CF carrier screening itself and to respond to follow-up questionnaires after the participant had received test results. Study staff were present at selected sites (a hospital obstetric and gynecology clinic for a week, a local high school that served as a site for public access, and a CF Walk-A-Thon [V. L. Hannig, J. P. Pfotenhauer, P. Grimm, and E. W. Clayton]) to answer questions about the study, to determine whether the presence of personnel would increase participation, but neither office personnel in the participating medical practices nor study staff actively solicited participation in the study.

In addition to these efforts, we offered carrier screening through the research protocol more intensively to the Vanderbilt community. After putting articles describing the study in numerous campus newspapers and putting signs in the hospital cafeteria and lobby, study personnel offered the study for 4 d in a busy lobby of the Vanderbilt Medical Center (V. L. Hannig, J. P. Pfotenhauer, and P. Grimm). Here as well, individuals were offered a free book about child care if they reviewed the educational materials and responded to the questionnaire. Vanderbilt personnel were also told that they could call the Vanderbilt Division of Genetics at any time, to participate in the study. Finally, in an effort to increase enrollment by the general public, stories describing the study and directing people where they might get more information were broadcast on local television stations.

Since CF carrier screening was offered under the protocol only if both partners were tested, individuals who were interested in having CF carrier screening after they viewed the educational materials were asked to take

copies of the written information and the questionnaire to their partners. Both partners were asked to sign the consent form for the screening; to obtain their own blood samples by finger stick, which were then placed on filter papers; and to return the forms and the filter papers to one of us (J.A.P.) for analysis of the six most common mutations. Couples were sent their results by letter. If one partner was found to be a carrier, the couple was invited to come for free counseling, after which each partner was asked to fill out a questionnaire exploring both the partner's understanding of his or her test results and opinions about screening. If neither partner was found to be a carrier, the couple was asked to respond to similar questionnaires. Those who demonstrated inadequate understanding were also invited for counseling.

Attitude Study

In the last several months of the screening study, to determine the views of carrier screening that were held by the general population, we interviewed individuals visiting four of the sites that had been used in the screening study: (1) a hospital-based obstetrics and gynecology clinic, (2) a private obstetrics and gynecology clinic, (3) a hospital-based pediatric continuity and walk-in clinic, and (4) the busy lobby of the Vanderbilt Medical Center. Study personnel actively solicited adults visiting these sites to respond to the questionnaire, offering in exchange a free book about child care. No efforts were made to include the partners of participants. This study occurred in two phases. In the first phase, which was conducted at sites 1–3 listed above, subjects who completed the questionnaire were then given the opportunity to enroll in the screening study's protocol, in order to obtain free carrier screening. The second phase was conducted 3–4 mo later, after completion of the screening study. Since free CF carrier screening was no longer being offered, subjects visiting four sites in this phase were asked only if they would be interested in having free CF carrier screening were it available. Participants were asked their views about carrier screening in general and about CF carrier screening in particular, as well as demographic information. They were also asked to rate, on a five-point Likert-type scale, the importance of several factors in their decisions about whether to proceed with carrier screening. The items included in the questionnaire were based on the answers obtained in the screening study and on the responses provided by three focus groups conducted by graduate students in the Owen Graduate School of Business, under our direction. Individuals who felt that carrier screening should never be available were asked to respond to a more limited set of questions than were the other participants. Because this study explored only attitudes, these participants did not receive the educational materials that had been designed solely to convey factual information.

Protection of Human Subjects

Both studies were approved by the Institutional Review Board of Vanderbilt University Medical Center. A two-part consent process was used in the screening study. Participants were first asked to consent to review the educational materials and to answer a brief questionnaire. They were then asked to consent to CF carrier screening itself and to sign a form that repeated much of the information in the educational materials and that expressly discussed possible insurance risks and the limits of confidentiality. Because the questionnaire used in the attitude study sought no identifying information about the respondents, written informed consent was not obtained.

Statistical Methods

Continuous variables were compared by analysis of variance, followed by Wilcoxon rank-sum tests. χ^2 and Fisher's exact test (or extensions) were used for categorical data. For these analyses, responses of "a little important," "not important," and "don't know" were grouped together, for purposes of comparison. Educational level was grouped into three categories: high school graduate or less, some college or technical school, and college graduate or higher. Those who said that they were married, those who were not married but were planning to be, and those who indicated that they had a steady partner were considered to be in a steady relationship, whereas those who gave other answers were not. We do not report results for multivariate models, because the high correlations between some of the variables could lead to spurious results.

Results

Screening Study

During the period that free CF carrier screening was offered, 68 people visiting sites other than the medical center lobby elected to participate in the study. We conservatively estimate that >125,000 nonpregnant adults would have viewed the signs in the course of their checking-in to receive medical care. Many thousands were known to have read the introductory letters. Both the distribution of people who actually elected to receive information about CF carrier screening at these sites and estimates of the number of people who visited the sites while the study was occurring are summarized in table 1. Placing study personnel in the university-based obstetric and gynecology clinic to answer questions about CF carrier screening and about the study protocol did not increase the enrollment of patients at that site. After the

Table 1

Sites, Other than Vanderbilt Medical Center Lobby, Where Subjects in Screening Study Were Enrolled

Site	No. Who Enrolled[a]	Estimated No. of Contacts/Wk[b]	Estimated No. of Contacts during Study Period[b]
University ob/gyn clinic	6	150	16,500
Private ob/gyn practice	6	175	12,250
Infertility clinic	12	40	4,800
University continuity pediatric clinic	9	220	24,200
Employee health services	6	150	16,500
Private pediatric practice	2	600	66,000
Public health clinic	13	50	6,500
CF Walk-A-Thon	8	...[c]	300
Public walk-in at high school, after Walk-A-Thon and community-based advertising	6	...[d]	1,000
OB/gyn practices at another hospital	0	...[e]	...

[a] Includes persons who actually obtained information at the site, as well as their partners.

[b] Our conservative estimates of the flow of nonpregnant adults through the site.

[c] The CF Walk-A-Thon took place on 1 d.

[d] The public high school was chosen as a site available to the general public and was open for 5 d; the nos. reported reflect only walking traffic. Large portable signs advertising the availability of testing, however, were placed on one of the busiest streets in Nashville.

[e] We elected not to provide an estimate here, because the signs were up in numerous offices for variable lengths of time.

media campaign, directed toward the ~10,000 employees of Vanderbilt, of whom ≥7,200 work in the medical center, as well as toward patients in the hospital, 170 people enrolled in the lobby of the medical center.

In all, a total of 238 people reviewed the educational materials and returned the questionnaires. Of these, 211/238 (89%) expressed interest in having the test, and 179/238 (75%) individuals submitted blood samples. The demographic characteristics of those who participated in the screening and attitude studies and of those who completed screening are summarized in table 2. Since the majority (170/238 [71%]) of those who participated in the screening study enrolled in the lobby of the medical center, >90% of those who chose to receive information about carrier screening had graduated from high school, and one-third had advanced degrees. Although this information was not explicitly sought in the screening study, review of the completed forms revealed that at least one-third of those who received information were health-care professionals. In addition, 14% of those who sought information had a family history of had CF, and 6% of those who got information stated that they had a child with a serious medical problem. Some 72% of those who were interested in screening had at least a college degree.

Those who stated that they wished to have CF carrier screening were asked to check which of a number of reasons explained their decision. They were allowed to check more than one response. Some 52% of those who were interested in being screened believed that getting tested was the right thing to do, 52% wanted to know for their children's sake, 25% said that they would change their plans about having children if they were found to be a carrier, and 17% said that they were getting tested because their partner wanted them to do so. Some people who expressed interest in screening gave no reason at all for their decision. Even though 59 participants did not submit samples, only 11 people actually said that they did not want to have CF carrier screening.

We asked all the participants in this study what they thought was the best time to have CF carrier screening. Of the 211 people who responded to this question, 156 (74%) opined that the best time to have this test was prior to pregnancy, whereas 26 (12%) indicated that the test was best done when choosing a partner; only 2 (1%) thought that it was best to have CF carrier screening during pregnancy.

The 59 people who participated in the study but who decided not to submit samples were not randomly distributed among the study sites ($P < .001$). Of those who obtained information, answered questions, and then chose not to go forward, 43 enrolled in the medical center lobby, 6 at the CF Walk-A-Thon, 9 in the public-health clinic, and 1 in the pediatric-continuity clinic. When compared with those who received information but did not submit samples, those who elected to be screened were more likely to be male ($P < .01$), to be white ($P < .001$), to say that their partners wanted them

Table 2

Demographic Characteristics of Participants in Screening and Attitude Studies

Characteristic	Screening Study (n = 238)	Submitted Samples (n = 179)	Attitude Study (n = 635)
Mean age (years)	31 ± 8	31 ± 8	31 ± 9
Gender (% female)	56	50	84
Race (% White)	96	99	74
In steady relationship (%)	91	92	84
Family history of CF (%)	14	16	5
Had heard of CF previously (%)	84	87	72
Prior education (%):			
High school or less	9	7	27
Some college	19	15	28
College graduate or higher	72	78	44
Working outside home	87	88	60
Working in health care	...[a]	...[a]	28

[a] Not asked.

to be screened ($P < .001$), to say that they would change their plans about having children if they were found to be carriers ($P < .01$), to be better educated ($P < .01$), to have some prior knowledge of CF ($P < .05$), and to understand that the test did not detect all carriers ($P < .01$). Those who were randomized to receive written information were far more likely to submit blood samples than were those who viewed the videotape (50/71 [70%] of those who received written information, vs. 26/58 [45%] of those who viewed videotape; $P < .01$). Those who submitted samples tended to have a family history of CF ($P = .08$). Similar trends were observed in comparisons between the responses of those who expressed interest in screening but who chose not to submit samples and the answers of those who expressed interest and completed the study.

Attitude Study

Far more people were willing to answer questions about their views regarding genetic testing. A total of 635 people enrolled at the four sites in <2 wk, and we estimate that well over 80% of those approached agreed to participate. Of these participants, 308/635 (49%) people enrolled in the first phase, in which they were offered CF carrier screening, whereas 327/635 (51%) enrolled in the second phase, in which participants were asked only if they would like to have screening if it were available. The demographic characteristics of the subjects in the attitude study are summarized in table 2.

When respondents in the attitude study were asked whether carrier testing should be available, 29% said that testing should be encouraged, and 8% said that tests should be required. By contrast, only 19 people (3%) said that tests should never be available. Two-thirds (411/616) of the respondents said that they would accept an offer of free carrier screening for a common genetic disorder. Yet, when 192 of these 411 participants were offered free CF carrier screening, only 62/192 (32%) expressed interest; of these, few asked the study personnel for educational materials, and only 4/192 (2%) of those offered CF carrier screening actually submitted blood samples, confirming our observations of minimal interest in the screening study.

Those participants who were not completely opposed to genetic testing were asked to rate the importance of various factors potentially affecting their own decision making. Their responses are shown in figure 1. The relative importance attributed to the various factors did not correlate with the order in which the questions were presented. Although, with regard to the order in which they ranked the importance of the various factors, there were very few differences between men and women and between those with higher and lower education, these and other differences did emerge in analyses to detect which characteristics and stated beliefs of the individuals were associated with the weights that they ascribed to various factors. The associations that reached significance are summarized in table 3.

We ascertained the respondents' views about many aspects of carrier screening itself. Only 11 (12%) of the 89 individuals who indicated that genetic testing was meddling in God's plan also stated that carrier testing should never be available. The respondents gave widely varying estimates of their risk of being a carrier. For example, 106/617 (17%) of the respondents said that their risk of being a carrier of a gene for a genetic disorder was medium or high. Although this estimate is in many ways accurate, since everyone carries mutations

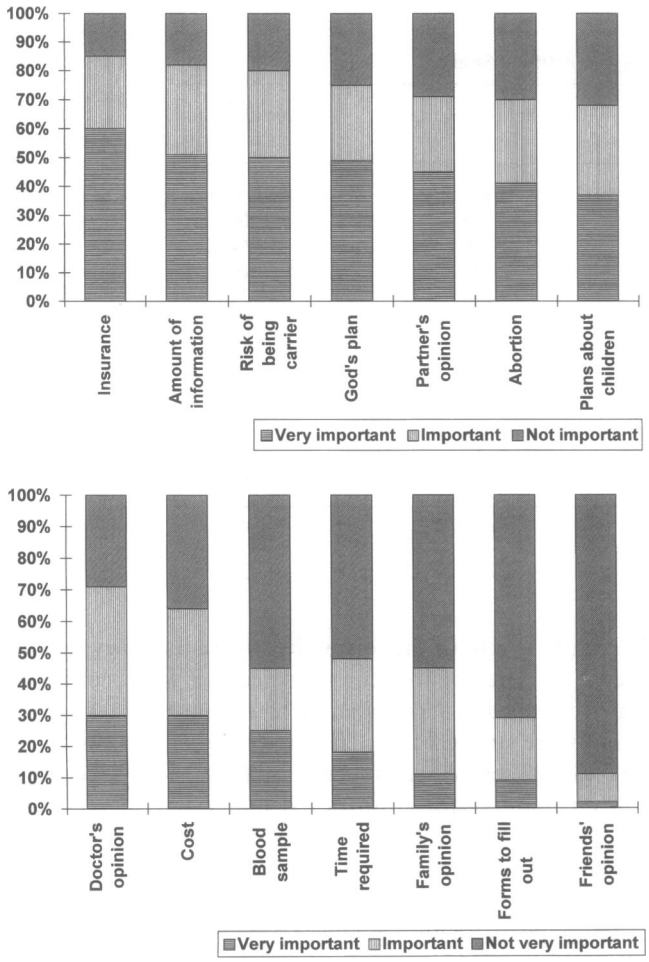

Figure 1 Importance of factors in decision making

for some disorders, the risk of carrying a mutation for any particular disorder is low. Importantly, 92/617 (15%) said that they had no risk of being a carrier, a response that is clearly incorrect.

When we asked the respondents what impact they believed being a carrier would have on their access to health insurance, 233/603 (39%) of the respondents who answered the question believed that those who were found to be carriers had a medium or high risk of losing their health insurance. Of the 364 people who said that the impact of carrier screening on access to health insurance was very important, 108/364 (30%) believed that the risk that a carrier would lose insurance was high, whereas 31/364 (9%) said that there would be no such risk at all.

The respondents' perceptions of what they thought their relatives or potentially important individuals believed about the desirability of genetic testing are summarized in figure 2. Of the participants, 60% overall (77% of those who expressed an opinion about what they thought their partners believed) opined that their partners favored carrier screening. More than one-third of the participants who answered the question (223/598 [37%]) did not have an opinion about what their physicians thought about carrier screening, but the overwhelming majority of the remainder (343/375 [91%]) believed that their physicians favored carrier screening. Family and friends were also thought generally to favor screening.

Two-thirds of the participants indicated that the opportunity to use a buccal swab instead of a finger stick would not affect their decisions about screening, whereas only 25% of the respondents overall said that they would be more willing to have carrier screening if they "only had to swab rub the inside of [their] mouth[s] instead of giving a blood sample." Even when we looked only at the responses of those who said that the need to give a blood sample was very important to their decision making, only 37% of these indicated that they would be more willing to have screening if they needed only to provide a buccal swab, whereas most (55%) indicated that the ability to use a buccal swab would not affect their choice.

Discussion

In our screening study, very few couples chose to be tested. Only ~5% of people visiting the clinics and public sites read the introductory letters, and far fewer than 5% of those who read the letters in the clinics and other sites requested the educational materials. Even after an extensive media campaign and the presence of study personnel with cookies in the lobby, only 1%–2% the people who work at Vanderbilt decided to request information about CF screening. Those who reviewed the materials—and especially those who accepted screening no matter where they enrolled—differed statistically from the general population (U.S. Department of Commerce 1993; Vickers and Cunningham 1993). They were more educated, more often worked outside the home, more often worked in health care, more often were white, and more frequently had a family history of CF. The latter two characteristics suggest that people who are at lower risk of being carriers tend not to be screened, a desirable outcome in terms of use of resources. We were particularly pleased to observe that screening was more often used by individuals who understood that the test did not detect all carriers, a finding that supports our earlier findings that both our written and videotape educational materials were effective in conveying information about CF carrier screening (Clayton et al. 1995).

We were most struck by how few people chose to be tested, particularly in light of the early predictions of

Table 3

Associations between Characteristics and Stated Beliefs, and Weight Ascribed by Participants Not Generally Opposed to Genetic Testing, to Selected Factors That Could Affect Their Decision Making

Factor Important to Decision Making	Associated Characteristic and Stated Belief	*P*
Insurance	Believed that risk of losing health insurance was high	<.0001
	More education	<.001
	White race	<.001
	Did not have child with serious medical problem	<.01
	Working outside home	<.01
God's plan	Genetic tests are meddling in God's plan	<.0001
	Female	<.0001
	Opposed to abortion for medical reasons	<.0001
	Less education	<.0001
	Younger age	<.01
Abortion	Older age	<.0001
	More education	<.001
	White race	<.01
	In stable relationship with another person	<.05
Partner's opinion[a]	In stable relationship with another person	<.0001
	White race	<.001
	More education	<.001
	Working in health care	<.05
Physician's opinion[a]	Less education	<.05
	Non-White race	<.05
	Younger age	<.05
	Not in stable relationship with another person	<.05
Concerns about need to provide blood samples	Less education	<.0001
	Non-White race	<.0001
	Not working in health care	<.01

[a] Questions asked only how important these individuals' views were to the participants, not what the participants believed that these other individuals thought about genetic testing.

widespread interest in CF carrier screening. We therefore focused on trying to understand this observation. When we surveyed individuals who visited sites that offered screening, they espoused several views that would have led us to predict greater participation than we observed. The overwhelming majority of the respondents stated that carrier screening in general should be available, if not encouraged or even required. Even though the respondents in the attitude study were not asked to involve their partners or others in the study, most believed that their partners, physicians, family, and friends favored carrier screening, and most said that the views of their partners and physicians were important in their decision making. People varied, however, in the weight that they gave to the views of various potentially important others. The partners' views were more important to people who were more educated, white, and in a steady relationship, whereas the physicians' views were more important to participants who were relatively young, not white, less educated, and single. In the end, almost all the respondents indicated that some person whose views they felt were important favored genetic testing. In other studies, approval by important others has been strongly associated with use of genetic testing (Wertz et al. 1992). Two-thirds of those surveyed in our attitude study said that they would accept an offer of free carrier screening.

The Potential Impact of Greater Information

The respondents expressed many concerns about carrier screening. Some of these worries appeared to be based on inaccurate information. For example, one-third of the participants may have misunderstood their risk of being a carrier, saying either that they had no risk or that their risk was medium or high. A more accurate understanding might have led to greater interest for the first group and to less fear for the other. One-third of the respondents also stated that people who were found to be carriers had a significant risk of losing their health insurance. Although it is difficult to determine with certainty the impact that being a carrier has on access to health insurance, the available evidence

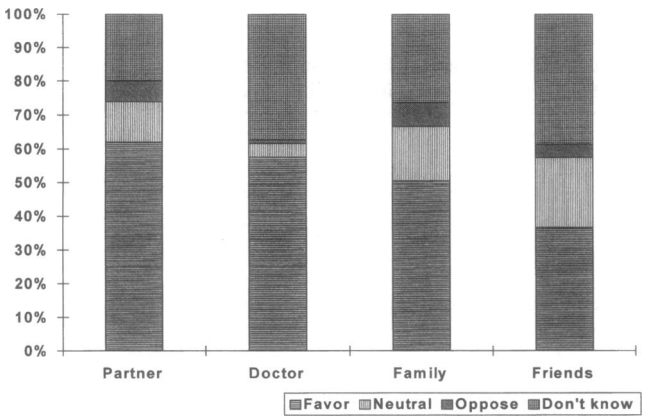

Figure 2 Respondents' beliefs about the opinions of others about genetic testing.

suggests that, although some people appear to have been denied or lost health insurance for this reason, the number of individuals so affected is not large (Billings et al. 1992; Natowicz et al. 1992). Helping individuals to achieve a more accurate appreciation of the magnitude of these risks could allay some of these concerns.

The Potential Impact of Changes in the Protocol

The fact that people who viewed the videotape were far less likely to proceed with testing than were those who read the handout was unexpected, since both educational approaches contained the same factual information. Those who viewed the videotape may simply have been "turned off." Another possibility is that the mere event of viewing a videotape made participants more likely to feel that they had a true choice to make about whether to have screening. Patients in health-care settings may respond to written material as something provided in preparation for signing a form. Another possibility is that this particular videotape, which portrayed a conversation between two people who are trying to decide whether to have CF carrier screening but who do not reach a conclusion, made the availability of choice more apparent. Further study is needed to determine which of these explanations is valid, but, even had we used only the written materials, the overall use of CF carrier screening still would have been very low.

Only a small portion of the respondents' concerns could be alleviated by changes in the protocol. Most respondents denied that the needs to provide blood by finger stick, to take time, and to fill out forms were significant barriers to their participation. The responses to the questionnaires provide little support for the notion that the decision to test couples rather than individuals substantially decreased the number of people who accepted screening. Few of those who participated in the screening study declined testing because they thought that their partner would not be interested, and, as noted above, most of the people whom we asked in our attitude study said that they believed that their partners favored carrier screening. Yet, the fact that more women than men (43 vs. 16) accepted information about screening but did not submit samples for the actual test suggests some reason to suspect that our decision to test couples led to lower use of screening. We hypothesize that part of the reason for the women's disproportionately high dropout rate was that the women participants more often found their partners to be unwilling to take part than did the men who chose to receive the information.

Besides the one that we chose, there are other strategies for providing carrier screening for autosomal recessive disorders. One is a sequential approach, in which one partner is tested first and the other partner is tested only if the first is found to be a carrier. Assuming that averting the birth of affected children and decreasing the adverse consequences of prenatal diagnosis are the goals for carrier screening, Asch and his colleagues have argued that sequential testing is the most cost-effective approach (Asch 1993; Asch et al. 1993). Another strategy is to view the couple as a reproductive unit and to test both members simultaneously, reporting as at risk only those couples in whom both members are shown to be carriers (Wald 1991; Doherty et al. 1994). The argument made for this approach is that there is no reason to inform couples if only one is a demonstrable carrier, because, in that setting, there is no reliable regimen for diagnosing affected fetuses. A third approach is to offer screening to individuals (Tambor et al. 1994).

For several reasons, we chose to offer carrier screening to couples broadly defined, at a variety of sites; to require participation of both partners; and to report each person's results. By requiring participation of both partners and by offering the test at a variety of sites besides obstetricians' and gynecologists' offices, we made clear that CF carrier screening, like screening for other autosomal recessive disorders, is not just the woman's problem. Most genetic tests, including carrier screening, are performed in obstetric and gynecology practices, so that the burden of choosing whether to be tested falls primarily on women. There is much evidence that, even in autosomal recessive disorders, in which, to be affected, a child must receive an altered gene from both parents, mothers generally feel more responsible for their child's illness (Rothenberg and Thomson 1994). We also chose to report both partners' results, because each partner has an interest in his or her status, especially in view of the likelihood that some who have carrier screening may subsequently have children in relationships with other partners.

It is not clear what the participants meant when they indicated that, in their decision making, the amount of information necessary was an important aspect of the carrier-screening process. They may have meant that they would have been more willing to have carrier screening if they did not have to learn about it. This posture, however, is inconsistent with the norms of informed consent (Katz 1984; Faden and Beauchamp 1986). The experience with other population-based carrier-screening programs in the past also suggests that allowing people to participate without knowing what is at stake is ill advised (Committee for the Study of Inborn Errors of Metabolism, National Research Council 1975; Reilly 1977).

Concerns beyond the Control of the Health-Care System

Prominent bases for reluctance toward carrier screening were opposition to abortion and ascribing importance to God's plan for one's life. These views were held by individuals of all races, ages, and educational levels. Only female gender was consistently associated with ascribing importance to abortion and God's plan. Such opinions are often very strongly held, and frequently they are not amenable to change by health-care providers. To our knowledge, other studies have not attempted to ascertain the effects that religiosity has on attitudes about CF carrier screening, so it is difficult to know precisely how important these views would be in other parts of the country; but, in light of the increasing prominence of religious belief in our national political discourse, there is every reason to believe that religious beliefs would be significant throughout the country.

Reconciling Our Observations with Those of Others

How, then, are we to understand the levels of acceptance of CF carrier screening, among individuals without a family history of CF, that have been observed in other settings? Carrier screening is often thought to be more acceptable ethically than prenatal diagnosis, because those who are tested prior to pregnancy and found to be at increased risk have more options if they wish to avoid having an affected child. In addition to selective abortion or preparation, which are the usual options following prenatal diagnosis of a disorder in the fetus, couples who are not yet pregnant can use alternative methods of reproduction, such as either artificial insemination by donor or egg donation; can simply avoid having children altogether; or can proceed with having biological children (Lipkin et al. 1986; Committee on Assessing Genetic Risks, Division of Health Sciences Policy, Institute of Medicine 1994). Like others, we found that most people opine that it is best to have CF carrier screening prior to pregnancy (Botkin and Alegmagno 1992).

Yet, the use of CF carrier screening by nonpregnant individuals and couples reported by other investigators is quite variable. Williamson and his colleagues have reported that thousands of people in England have accepted the use of buccal swabs for CF carrier screening (Watson et al. 1991). Marteau and her colleagues, by contrast, have argued that the rate of utilization is highly sensitive to both the role of the health-care provider and convenience. They found that people are much more likely to accept screening if it is recommended by their physicians and if the test is readily available (Bekker et al. 1993). The latter observations are similar to those of Holtzman and his collaborators, who offered CF carrier screening to members of an HMO affiliated with Johns Hopkins University. When members of childbearing age were sent a letter inviting them to come to the HMO for an educational session, only 4% participated. In an effort to increase participation, study personnel went to the waiting rooms of two different offices of the HMO, where they approached members, gave them informational materials about the test, offered to collect buccal swabs at the time, but told the members that the test would be performed only if they then sent in a consent form. Under these circumstances, ~24% of those eligible chose to have the test (Tambor et al. 1994).

By contrast, investigators in Los Angeles, northern California, and Edinburgh all have reported that well over half of all pregnant women accept this sort of screening (Mennie et al. 1992; Witt et al. 1992; Grody et al. 1994). It may be that these women saw CF carrier screening as simply another of the many tests that women currently receive as a "routine" part of prenatal care (Lippman 1991). It is also possible that during pregnancy they are more anxious about the health of their future children. Whatever the reason, the higher level of use of CF carrier screening during pregnancy than before conception is consistent with the observation that most other carrier-screening tests are also used primarily after conception (Kaback et al. 1993; Tambor et al. 1994). It appears, moreover, that the willingness even of pregnant women to pursue CF carrier screening is relatively soft, since imposing relatively small barriers, such as a $50 charge or a need to travel a small distance, will deter them from beginning the process of CF carrier screening (Asch 1993).

We conclude that, although most people appear generally to view genetic testing with favor and to believe that others who are important in their lives also favor testing, those who do not have a family history of CF usually do not, prior to pregnancy, elect to pursue free carrier screening for this disorder, unless it is offered by their health-care provider. When asked about issues that

could affect their decisions regarding genetic testing, people in the general population demonstrated worries about a number of factors, such as the concept of being "at risk," insurability, what they would need to learn, abortion, and religious beliefs. Most of these concerns reflect views about the health-care system, society, and themselves, rather than misperceptions of genetic facts. These findings add to the observations of others that reproductive genetic testing is not always viewed as an unmitigated blessing (Lippman 1991; Rothenberg and Thomson 1994).

What implications does this observation have for population-based CF carrier screening? We observed that in the general population there is no groundswell of demand for CF carrier screening. We agree with Marteau and her colleagues that the higher levels of "uptake" observed in other studies may reflect more "supply push" than "demand pull" (Bekker et al. 1993). Since we believe that the goal of reproductive genetic testing is to address the needs and concerns of individuals who are making decisions about childbearing, we conclude that clinicians should not incorporate CF carrier screening into the routine medical care of nonpregnant people who do not have a family history of this disease.

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