Grading the Gene Tests

by John Rennie, *staff writer*

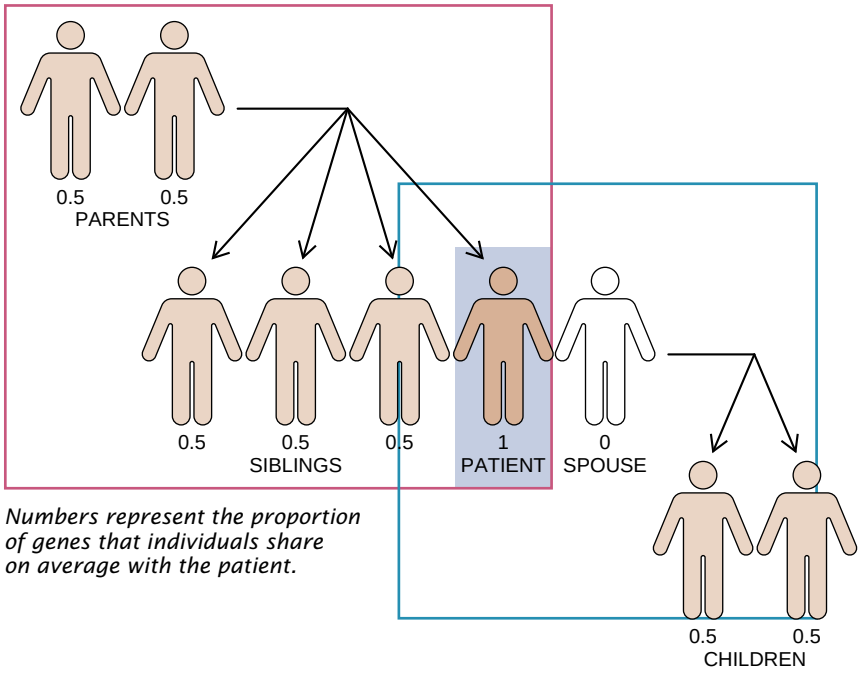
Almost nine months before she was born, Brittany Nicole Abshire passed the most important test she will ever take. Her parents, Renee and David, are both healthy carriers of the trait for Tay-Sachs disease, a cruelly disabling and ultimately lethal inheritable disorder. After they lost one daughter to Tay-Sachs in 1989, they swore they would never have another child unless they could be sure that it would be free of the disease. Genetic tests could diagnose the condition before birth, but the Abshires' religious beliefs ruled out abortion as a way of screening for healthy fetuses.

There seemed to be no hope until the Abshires learned about a new technology called preimplantation genetic testing. The experimental procedure had already been used to screen more than a dozen children for a different genetic disorder, cystic fibrosis. Gary D. Hodgen and specialists at the Jones Institute for Reproductive Medicine at the Eastern Virginia Medical School collected ova and sperm from the Abshires and successfully fertilized seven ova in vitro. After three days, when those seven had developed to about the eight-cell stage, Hodgen's team plucked a cell from each pre-embryo and tried to analyze its DNA.

For four of the pre-embryos, the analysis worked: one of them showed the deadly combination of genes, but three were not even carriers. Those three pre-embryos were implanted in Renee, and one survived to become Brittany, who was born this past January. Courtesy of genetic testing, Brittany is the first child ever certified to be free of Tay-

***EIGHT-CELL EMBRYOS** like the one shown at the left can now be screened for the presence of some genetic illnesses. Baby Brittany Nicole Abshire* (right) *was tested in this way because both of her parents are carriers of the fatal Tay-Sachs disease gene.*

From just a snippet of DNA, geneticists can sometimes forecast a patient's health. But ethical problems surrounding this testing are as ominous as the diseases themselves



Numbers represent the proportion of genes that individuals share on average with the patient.

GENES ARE SHARED by members of a family. If one person carries a gene for a disease, then each of his or her parents, siblings and children has a 50 percent chance of carrying the same gene. That fact affects the privacy of genetic data.

Sachs disease before entering her mother's womb.

As the era of genetic testing dawns, miracles such as Brittany could become commonplace. Genetic testing is the fastest-growing area in medical diagnostics: according to the Office of Technology Assessment (OTA), the number of genetic tests will increase 10-fold over the next decade. "Potential new genetic tests roll off the conveyor belt of the Human Genome Project almost once a week," remarks Norman Fost of the University of Wisconsin–Madison Medical School. Hundreds of thousands of fetuses are already being tested every year by techniques such as amniocentesis and chorionic villus sampling.

Tests are not just for the unborn: many can also be used to diagnose illnesses more accurately in children and adults. In the past year alone, researchers have found genes associated with Alzheimer's disease, Huntington's disease and colon cancer; they expect to find a breast cancer gene almost any day now. Tests based on those and other discoveries could warn people that they are at special risk for those diseases. And used in conjunction with prospective therapies that replace defective genes with working ones, genetic tests could lead to real cures.

But many human geneticists and other observers are concerned that the rapid growth of genetic testing is already posing ethical, legal, social and scientific quandaries for which there will be no easy answers. They fear that new tests are proliferating without adequate supervision. Because the genetics of disease is proving to be more complex than anticipated, the predictive power and utility of some tests are in question. Yet states are enthusiastically instituting programs for screening newborns that may be unnecessary. Meanwhile investigators are beginning to see evidence that "genetic discrimination" is costing some people jobs and insurance.

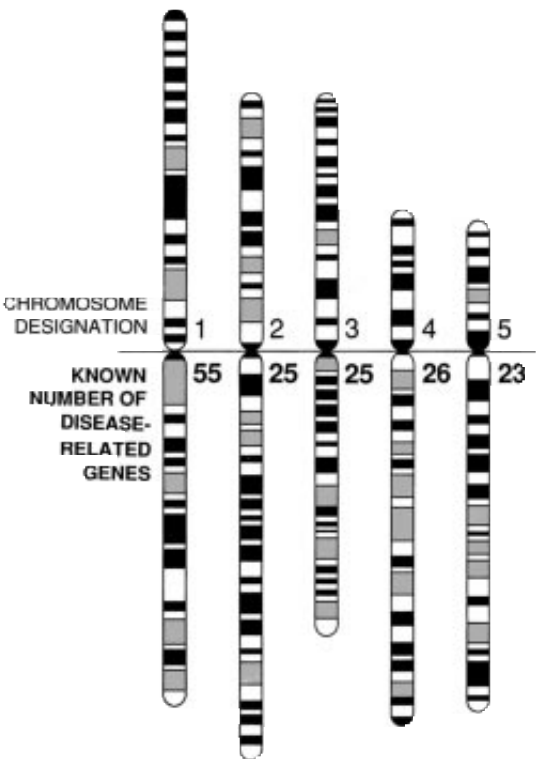
"We need to proceed cautiously, because there is a potential for doing harm with this technology," warns geneticist Michael M. Kaback of the University of California at San Diego, a pioneer in population screening. When we know more about a human's genetic makeup than ever before, will we know what to do with all that information?

A Mythological Model

Genetic testing is not a single technology. Rather it refers to a broad range of methods for gauging the presence, absence or activity of genes in cells. At the relatively low-tech end, researchers can count the chromosomes in a patient's cells or measure the amount of telltale proteins in his or her blood. At the most sophisticated level, researchers assay a cell's DNA with molecular probes that can find a specific genetic sequence among the three billion base pairs that make up human DNA. Some tests cost as little as $50, whereas others are more than $1,000. With these tests, medical geneticists can try to predict the course of a patient's health.

Unfortunately, the more that researchers have learned about human genetics, the more they have come to appreciate that even seemingly straightforward diseases are complicated. Notions of genetic illness have often been built around the single-gene model, in which a defect in a gene causes a particular health deficit. Some diseases do work this way: the deformed blood cells of sickle cell anemia are caused by a gene that makes an abnormal form of hemoglobin; the fatal miseries of Tay-Sachs result from the lack of an enzyme that breaks down fatty substances in neurons. But this model is turning out to be an oversimplification.

No more than about 3 percent of all human diseases are caused by defects in a single gene, and none of those are major killers, as are heart disease and cancer. The more complex conditions involve a host of genes that merely nudge a person's predisposition to develop an illness. According to most estimates, everyone carries at least five to 10 genes that could make him or her sick under the wrong circumstances or could adversely affect children. "We're all mutants," Kaback summariz-



es. "Everybody is genetically defective."

The truth is that the rules for what constitutes a genetic disease are not clear-cut. If researchers someday find a gene that confers a 60 percent predisposition for gross obesity, is that a genetic defect? What about a gene that gives a 25 percent predisposition for cardiovascular disease at age 55? Or—moving into an even more ambiguous area—a gene that predisposes to antisocial behavior?

Furthermore, even some diseases that once appeared to fit the single-gene model on the basis of their hereditary patterns are more variable than had been assumed. Cystic fibrosis, one of the most common hereditary disorders among people of European descent, is a useful example. Its symptoms include the accumulation of suffocatingly thick mucus in the airways and often severe digestive problems. Today drug treatments allow half of all cystic fibrosis sufferers to live to about age 30, but just a couple of decades ago patients rarely survived into their twenties, and some still die in infancy.

Researchers had often prayed for a genetic test that could find carriers of the disease in the general population. Then, in 1989, investigators at the University of Michigan and the University of Toronto found the gene responsible for cystic fibrosis on chromosome 7; it encodes a protein in cell membranes that affects the intracellular balance of chloride ions. DNA-based tests for mutations commonly associated with the disease soon appeared.

But those tests have revealed a new class of cystic fibrosis patients—people with relatively minor symptoms, such as asthma or bronchitis, who never thought of themselves as genetically ill. Some male patients are perfectly healthy except that they are infertile—for reasons not yet understood, they lack a vas deferens, the tube in the reproductive system that conducts sperm cells from the testicles. Basically, cystic fibrosis is not a single disease after all.

Moreover, molecular biology has revealed that cystic fibrosis is not caused by a single type of mutation. Although one mutation is associated with 70 percent of all cases, and two others with another 15 to 20 percent, more than 360 mutations have been linked to cystic fibrosis so far. No one has yet been able to correlate firmly the severity of the disease with different mutations. And DNA tests designed to catch one mutation will miss others.

All these discoveries make it much harder to interpret the results of genetic tests for cystic fibrosis. A positive test result does not indicate how severely afflicted a patient will be, and a negative test result could be misleadingly reassuring. Thus, the DNA tests usually need to be confirmed by biochemical assays and monitoring for symptoms.

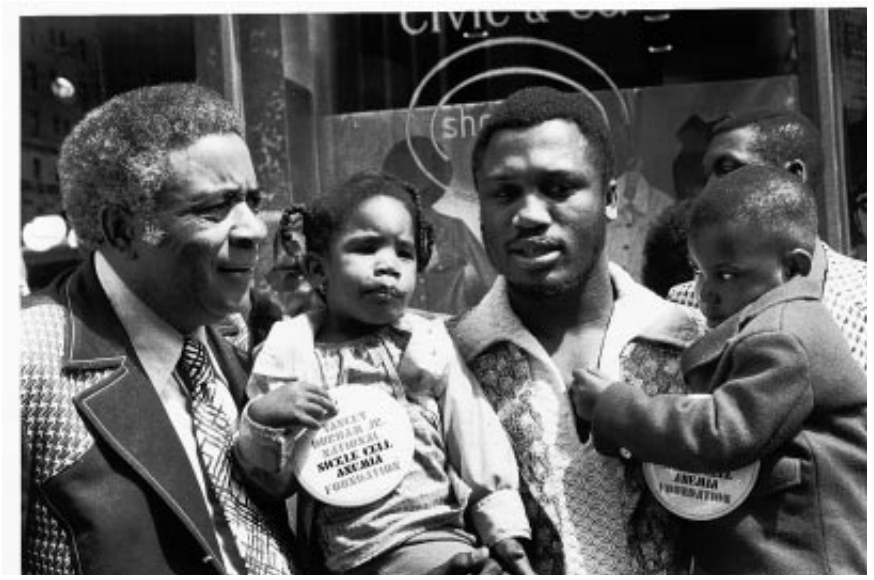
The problem confounding the single-gene disease model and the straightforward interpretation of the tests is what many observers call the myth of genetic determinism. "Genetic determinism is one of these simpleminded errors that we were prone to commit when we thought genes linked to diseases in a kind of inevitable, ineluctable fashion," explains Thomas H. Murray, director of the Center for Biomedical Ethics at the Case Western Reserve University School of Medicine and former head of a task force for the Human Genome Project. "It invites you to think that 'genes equal fate.' " Environmental circumstances, in the form of modified diets, therapeutic drugs, behavioral changes and other influences, can avert many disastrous outcomes foretold in the DNA. Conversely, because cystic fibrosis, heart disease, cancer, autoimmune disorders, multiple sclerosis and other conditions arise from an unfortunate confluence of genetic and environmental factors, genetic tests for those illnesses can never by themselves predict an individual's future with perfect clarity.

Damned by DNA

Against this backdrop of genetic interpretation (and misinterpretation), the drama of population screening is being played. In recent decades, several screening programs aimed at detecting genetic diseases in large groups of people have been attempted, some with good results, some with bad.

One nightmarish example of well-intentioned testing gone wrong is the screening campaign for sickle cell anemia during the early 1970s. In response to a groundswell of demands that something be done about the disease, which is a scourge of the African-American community, the federal government funded a screening program to detect carriers of the sickle cell gene. The program was easy to implement because carriers could be identified from just one drop of blood through an inexpensive test. At first, the screening enjoyed popular support. Some ministers conducted tests on their congregations; some members of the Black

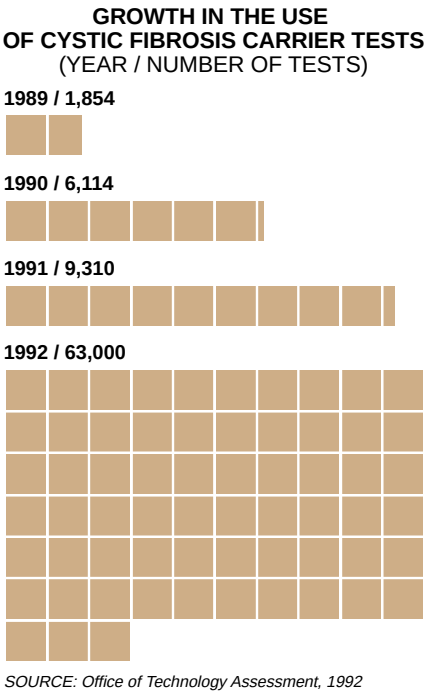
CHROMOSOME MAPS of the genetic traits for a variety of illnesses are still being compiled. Disease-related genes have already been located on each of the chromosomes, and new ones are constantly being discovered. The relation between genes and diseases is rarely simple, however. Almost all diseases are likely to have some genetic component.



MASS SCREENING for sickle cell anemia was at first popular among African-Americans during the early 1970s. Boxer Joe Frazier (*center*) is shown promoting one screening drive. Because the public was poorly educated about the meaning of the tests, the results were sometimes misused to discriminate against healthy carriers of the trait.

Panthers were offering the tests door-to-door in black communities.

But soon things turned ugly. Because people were rarely educated about the meaning of the tests, many perfectly healthy carriers of the trait were led to believe they were sick. This ignorance extended to some state governments as well. The Massachusetts legislature, for instance, passed a law requiring that all children at risk for "the diseases" sickle cell anemia and sickle cell trait be screened before enrollment in school. "By legislative fiat, sickle cell trait became a disease," Kaback moans.



TESTING FOR CARRIERS of cystic fibrosis has mushroomed in recent years.

Some insurance companies began to deny coverage to black carriers on the grounds that they had a preexisting medical condition or that their children were bad risks. The U.S. Air Force Academy rejected black applicants who were carriers. Some commercial airlines refused to hire carriers as flight attendants because of the erroneous belief that such individuals were particularly likely to faint at high altitudes. Prominent scientists suggested on network television that the best solution to the anemia problem would be for blacks carrying the gene to forgo breeding—a suggestion that naturally fed fears that the screening was really genocidal in intent. In short, the testing did more harm than good by becoming a tool of long-standing prejudices.

The Tay-Sachs program, which Kaback organized, is a shining example of what can go right with such an effort. Tay-Sachs disease is especially prevalent among Jews of eastern European descent. (The Abshires are not Jewish, but they come from a small community in Louisiana where the disease is also common.) Since the early 1970s more than a million Jews throughout the world have volunteered for testing to learn whether they are carriers of the recessive Tay-Sachs trait. When couples who both carry the mutation decide to have children, they typically elect to have prenatal testing. If a fetus has the disease, they usually abort it rather than give birth to a child who would succumb within five years to a horribly slow, painful death. More important, however, the tests also set at ease the minds of fearful couples who might otherwise never risk having children.

Why did the Tay-Sachs program succeed where the one for sickle cell failed? Kaback and others credit the care that went into its implementation. Before the pilot programs in Baltimore and Washington, D.C., began, 14 months were spent establishing contacts within the Jewish community and educating potential patients about the tests and their implications. People received extensive genetic counseling both before and after the tests. Unlike the screening for sickle cell anemia, the Tay-Sachs program was always voluntary, which meant that people had the opportunity to prepare for the consequences of the testing.

Another important difference, Kaback argues, lies in the diseases themselves. Because Tay-Sachs is always so uniformly hideous in its progression, extremely few people believe an affected child should be brought into the world. Because testing can prevent that tragedy, it carries a clear benefit. The benefits of sickle cell testing are less distinct. The severity of the disease is variable and intermittent, and with prompt medical attention, immunizations and antibiotic treatments (which alleviate the frequent bacterial infections that accompany the anemia), patients can live for many decades. Relatively few people believe aborting an anemic fetus on the basis of a genetic test is humane, so the test has less obvious utility.

Learning the Lessons

The Tay-Sachs model for screening has been successfully adapted for some other diseases. For instance, prudent testing has greatly cut the incidence of thalassemia, a genetic blood disorder common among many people of Mediterranean descent: in Sardinia, the rate of thalassemia has declined from one in 250 births to one in 1,200 births during the past 20 years.

Applying the lessons learned from the Tay-Sachs and sickle cell experiences is not always easy, however, especially for diseases in which the population at risk is extremely large. Once again cystic fibrosis serves as a useful example. In families with histories of the disease, screening is usually accurate and beneficial. But 80 percent of the children with cystic fibrosis are born to families without such histories, so nearly all couples in the U.S. would need to

be screened to prevent most cases. "How do you get four million pregnant women a year into an educational setting?" Fost asks. Given that the number of professional genetic counselors in the U.S. is barely more than 1,000, cystic fibrosis screening alone would swamp the country's counseling resources. Most patients would have to get counseling information from their primary physicians—many of whom have little or no training in genetics, according to surveys of the medical profession.

Yet many researchers believe, as Fost puts it, cystic fibrosis screening is "metastasizing, despite the lack of any evidence that it works." For the past eight years, investigators in Wisconsin have been conducting a double-blind study to determine whether biochemically screening newborns for cystic fibrosis is beneficial. So far they have found no evidence that identifying the children at birth is better than waiting for any symptoms to emerge. Nevertheless, in 1989 the states of Colorado and Wyoming both made cystic fibrosis screening mandatory for all newborns.

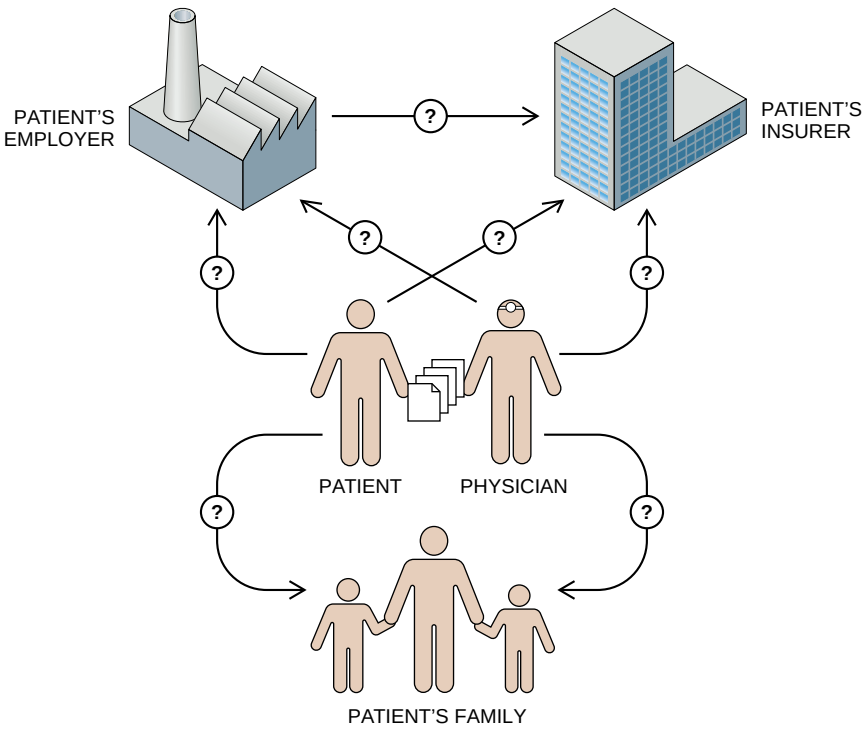
Because all genetic tests have some margin of error, excessive newborn testing has the capacity to do harm, if only by worrying parents unnecessarily. One study looked at families in which a child was initially diagnosed as having cystic fibrosis but was later shown to be healthy; one fifth of the parents nonetheless continued to fear that their children had the disease. Geneticists and ethicists often express concern about how stigmatizing children with a disease label may warp personal development.

In a report issued last November, the Institute of Medicine (IOM) of the National Academy of Sciences offered numerous recommendations about how genetic testing should be conducted to minimize its potentially adverse effects. All testing, it suggests, should be voluntary, and the results should be kept confidential to prevent misuse. All testing should be linked to genetic counseling, so that the patient understands the results and their implications. For the most part, tests should be restricted to those conditions for which some beneficial intervention is possible, either as therapy or as reproductive planning. Tests should not usually be performed purely for information's sake; rather the patient should be able to use the result to make an informed decision about an issue of immediate relevance, such as having a child or electing a medical treatment. The IOM also strongly believes an individual should decide freely whether or not to be tested, without social pressure or financial inducement.

Unregulated Testing

As good as those guidelines may be, abiding by them will be difficult. One problem with trying to set any limits is that genetic testing is so easy to do; another is that the field is largely unregulated. "Currently there is very little to stop someone from implementing genetic tests on a population basis without the sort of institutional review and informed consent required for other new technologies," Fost says.

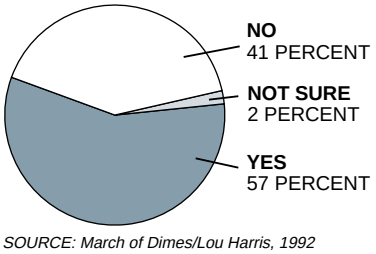
Neil A. Holtzman, a health policy expert at the Johns Hopkins University Hospital and an editor of the IOM report, notes that most companies in the business of genetic testing offer it as a laboratory service and not as a kit for physicians to use. They are therefore not obliged to submit their methods for appraisal and approval by the Food and Drug Administration. The companies do fall under the jurisdiction of the Clinical Laboratory Improvement Amend-



WHO SHOULD KNOW the results of genetic tests is an unsettled ethical and legal issue. Because the results of genetic tests may carry health and financial implications for others, a patient or physician may be obliged to divulge that information. In a 1992 poll, a majority of Americans said the privacy of test results should not be absolute.

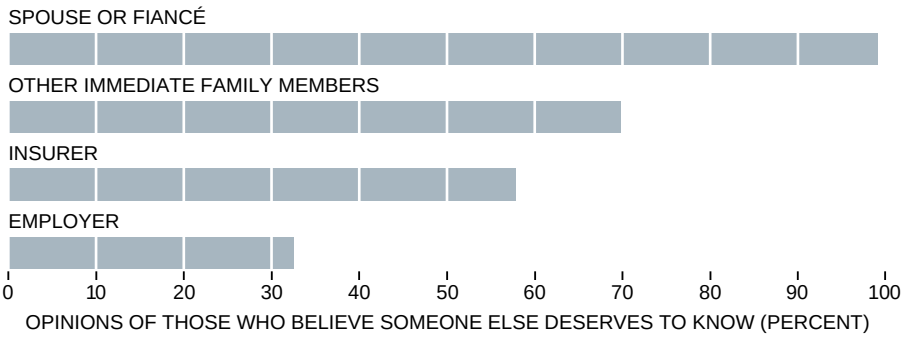
THE RIGHT TO KNOW

If someone is a carrier of a defective gene or has a genetic disease, does someone else deserve to know?



SOURCE: March of Dimes/Lou Harris, 1992

WHO SHOULD KNOW?



BREE WALKER LAMPLEY, a television and radio celebrity in Los Angeles, has ectrodactyly, a genetic condition that causes a deformity of the hands and feet. She was publicly criticized for having a baby in 1991 because her child had a 50 percent chance of inheriting that trait. (Her son did indeed inherit that gene.) Her case illustrates the social pressures that can be imposed on individuals who carry genetic defects.

ments of 1988. This law ensures that laboratories conducting interstate commerce in Pap smears and other biomedical tests meet certain standards of reliability. Unfortunately, Holtzman says, the Health Care Financing Administration, the agency empowered with enforcing those rules, "has really dragged its feet on setting up guidelines for these new genetic tests."

According to the IOM report, only 10 states have established any licensing requirements for genetic testing laboratories, and only New York State has comprehensive regulations that pertain to DNA tests. This lack of oversight worries Holtzman and the rest of the IOM committee about the possible margin of error in the test results. "I think we've already seen a couple of examples of companies seemingly getting tests out there without any regulatory brakes being put on," Holtzman charges. "If we don't get the proper regulatory authority in place, it's going to become a problem of too little, too late."

Critics also point out that many genetics researchers have financial ties to companies in the business of testing. "What I see my colleagues doing is isolating a gene, finding a single mutation and then jumping into population screening. That's not the way it should happen, in my opinion," Kaback says. "We've got entrepreneurial interests influencing judgments that people are making about when tests are ready to be deployed in the population."

Kaback and the rest of the IOM committee also worry about pressures being put on physicians to use genetic tests. "There are private companies sending letters to doctors all over the country, telling them they should be offering cystic fibrosis carrier testing to all their pregnant couples," he says. In these litigious times, many doctors may feel it is safer to order a test than to face charges of negligence.

Because of such concerns, several professional groups have issued statements that emphasize the experimental status of most genetic tests. The American Society of Human Genetics has twice announced that offering screening for cystic fibrosis carriers to the general public should not be considered the standard in medical practice. This past March, the National Advisory Council for Human Genome Research at the National Institutes of Health warned that screening for cancer should not be performed widely until more research on its reliability and consequences could be determined.

Genetic Privacy

Even if the accuracy and utility of genetic testing are assured, maintaining the privacy of that information will remain a problem. Your genes are not exclusively your own: you share half of them with each of your parents, siblings and children. If you discover that you carry a worrisome gene, you may have an ethical, if not legal, obligation to tell them. "There are ripples from genetic testing that don't have analogues in most other kinds of medical testing," remarks Arthur Caplan, a bioethicist at the University of Minnesota.

A 1992 March of Dimes poll reported that 57 percent of the public thinks someone other than a patient deserves to know that he or she carries a defective gene. Of those who believed so, 98 percent thought a spouse or betrothed should know. More surprisingly, however, 58 percent thought insurance companies should also be informed, and 33 percent thought an employer should be told. In a different study, physicians themselves disclosed a willingness to violate patient-doctor confidentiality in some cases: 54 percent said that, even over a patient's objections, they would tell relatives at risk about the results of a test for Huntington's disease (a lethal neurodegenerative disorder that usually manifests in middle age). Twenty-four percent said they would tell the patient's employer, and 12 percent would tell an insurance company.

Industry has also revealed an appetite for individuals' genetic information, although the limited predictive ability and high cost of the current tests seem to have restricted their appeal. A survey by the OTA released in 1991 tried to determine whether employers were conducting genetic tests as conditions of employment; such tests could theoretically reveal workers who would be particularly bad (or expensive) health risks. It found that in 1989 only 12 of 330 Fortune 500 companies were monitoring or screening for any reason. But more than half of the polled companies found the idea of monitoring acceptable, and 40 percent admitted that a person's health insurance costs might affect his or her chance of employment.

Bioethicist Thomas Murray has also found interest in genetic data among insurance companies. "If you ask the question narrowly, 'Are insurers requiring DNA tests of customers?', the answer is no," he says. "The tests are too expensive, not cost-effective, there aren't enough of them yet—there are a lot of reasons. But are insurers interested in genetic information, and will they be in the future? The answer to that is a resounding yes. The best genetic information right now comes not from genetic testing but from one's personal health history—what did your parents die of?"

The insurance industry itself confirms that view. A joint report issued in 1991 by the American Council of Life Insurance and the Health Insurance Association of America stated that although insurers would not be requiring tests in the foreseeable future, they should be

entitled to know the results of any genetic tests or other evidence of possible disease in a policyholder's record. Insurers maintain that they need this information not to discriminate genetically but to set fair rates for all policyholders. It would be wrong, they argue, to make healthy people pay higher premiums because they had been lumped in with those at higher risk. They also do not want to exempt genetic testing results from scrutiny because they say this precedent might someday preclude them from using other medical and statistical indicators of risk.

These arguments do not persuade Murray. "Insurers are applying a model of 'actuarial fairness' and justice they developed in the realm of commercial insurance," he replies. Those principles, in his opinion, are not relevant to health insurance, which serves social and humanitarian functions that deserve consideration. Because no one can control his or her genetic makeup, it seems wrong to penalize individuals for it.

Many observers also doubt the ability of insurance companies and other agencies to interpret genetic information wisely. Paul R. Billings, a geneticist now at the Palo Alto Veterans Administration Medical Center, has been collecting examples of people who were apparently discriminated against because of genetic information that became known to insurers, employers, health maintenance organizations (HMOs) and adoption agencies. He and his colleagues first published some of their results in the *American Journal of Human Genetics* in 1992. Several of the cases they described concerned people who were healthy carriers of genetic diseases or had extremely mild symptoms yet were still denied jobs or insurance coverage. One woman who applied to become an adoptive parent was rejected because her family history of Huntington's disease made her "too great a risk."

In another case, parents who had one child with cystic fibrosis conceived again, and prenatal testing confirmed that this second child, too, would have the disease. When the family's HMO learned that the couple intended to proceed with the pregnancy, it moved to withdraw or limit the entire family's health coverage. Only after threats of a lawsuit did the HMO change its mind.

Billings says a second report, listing about 100 cases of genetic discrimination, is almost done. With funding from the Human Genome Project, he and his co-workers have also been conducting a further survey of 30,000 people with genetic conditions. "Our preliminary view of that study is that it confirms genetic discrimination is occurring," he notes. A 1992 OTA report also found that about 15 percent of genetic counselors said some of their clients had experienced discrimination in insurance.

Outside the Law

Anyone looking to the law for protection from genetic discrimination would find a thin shield at best. At the federal level, most experts agree, the strongest statute for barring discrimination in the workplace is the 1990 Americans with Disabilities Act. But the relevance of that act to genetic information is still uncertain. The Equal Employment Opportunity Commission, which enforces the act, has already offered the opinion that healthy carriers of genetic diseases would probably not qualify as having a disability.

Some states have laws that protect the carriers of genes for sickle cell anemia and a few other specific traits found disproportionately among African-Americans and other groups whose members have been historical targets of discrimination. Somewhat broader legislation has been passed in Wisconsin and a few other states and is being debated in a number of others. In 1991 the California legislature passed a law that prevented any form of genetic discrimination, but it was subsequently vetoed by Governor Pete Wilson.

Because most concern about discrimination revolves around insurance coverage, insurance reform may be the key to a solution. "Our task force recommended that all individual risk information be excluded from decisions about who gets insured, what they get insured for and how much they get charged," Murray says. "We see no other practical, sustainable plan for health care coverage than community rating." Community rating, which was the basis for the first health insurance programs during the 1930s, is a system in which a customer's premiums are determined by the health profile of his or her community. Genetic information about individuals would be irrelevant.

The IOM committee and others also favor community rating for that reason. Insurers disagree, arguing that individual risk rating serves the public welfare more equitably at less expense. Nevertheless, for many reasons, the popularity of individual risk rating has been declining. In recent years, New York, Maine and a few other states have shifted to programs based at least partially on community rating.

Both insurers and their critics agree that reforms in health care financing are likely to render moot some—but not all—of the disputes about genetic discrimination in insurance. The details of the new health care system will be important. For example, some insurance plans that would meet the Clinton administration's standard of universal coverage might still be able to disallow coverage for certain genetic conditions. People with those traits might then have to buy additional insurance or pay some costs out of pocket. Under the current system, insurance companies and HMOs often resist paying for many genetic tests or for the costs of genetic counseling. It remains to be seen how reforms in health care financing will affect those policies.

Universal, comprehensive coverage could also become the in-

DOWN SYNDROME patients, who carry three copies of chromosome 21, exhibit a range of mental and physical impairments. But given the proper education and medical attention, many of them are accomplishing much more than was once believed possible. Predicting the limits of people with genetic handicaps is uncertain.

strument of a demon that has long haunted genetic technology: eugenics. The word immediately summons memories of the Nazi genocidal horrors and other atrocities, such as the forced sterilization of 30,000 people as "mental defectives" in the U.S. before World War II. Yet eugenics can arise through a seemingly more benign movement to ration social resources. Last December, China announced a policy of discouraging people at risk for hereditary diseases from having children, on the grounds that the genetically ill impose too much of a burden on society.

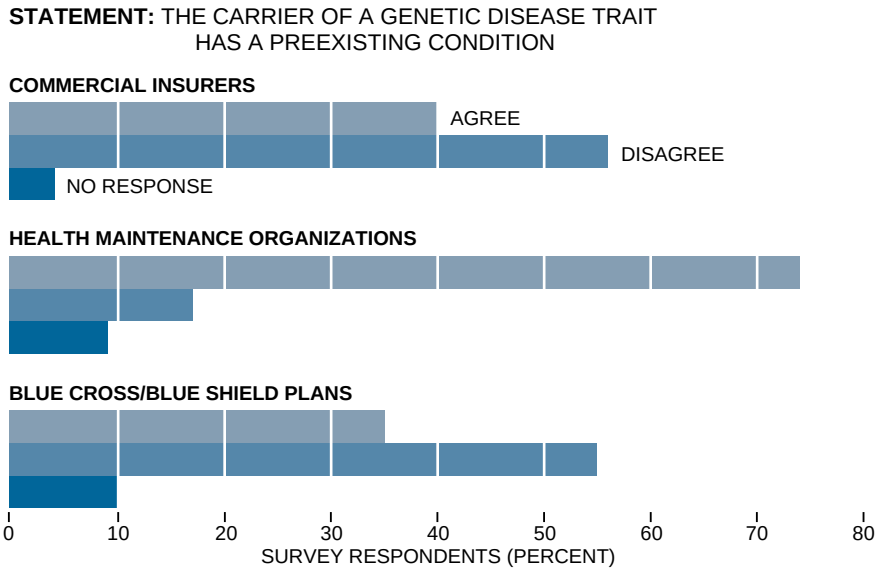
A Eugenic Democracy

The U.S. is not immune from such thinking. "If we get universal health care, people are going to want to know why they should be paying for the 'genetically irresponsible,'" Caplan believes. "In this country, eugenics is not going to come from a Hitlerian dictator saying, 'You must do this.' It's probably going to come from a society saying, 'You can have a kid like that if you want, but I'm not paying.'"

A counterargument might be that in a democracy, the public should be entitled to set limits on what costs individuals can impose on everyone. Yet such arguments, like those surrounding insurance, invariably depend on a definition of fairness. Moreover, whatever motivations lie behind the pressures being put on people making reproductive choices, their net effect is the same: society influences who will or will not be born. As Billings says, "Whether we want to dress it up in economic incentives, if you have to sell your house and go broke to have a child of a certain type, that's eugenics."

Because of its history, "eugenics" is perhaps too loaded a word to describe some applications of genetic testing. Holtzman and many others prefer to reserve it to describe circumstances in which a government or other agency intervenes in reproductive decisions. That is why, Holtzman says, the IOM committee so emphasized the importance of preserving personal autonomy: couples should weigh for themselves whether the risks of having a sick child outweigh other considerations.

"I think the goal of eliminating diseases and disabilities is a good one," Caplan affirms. "I don't think there's anything wrong with encouraging women at risk to be screened for spina bifida or to ask Jewish couples of eastern European descent to be screened for Tay-Sachs. It's wrong to confuse the goal of eliminating disease with the moral problem of coercion."



SOURCE: Office of Technology Assessment, 1992.

INSURERS' ATTITUDES toward people who carry the genes for disease traits may shape policies concerning the eligibility of those persons and their offspring for health care coverage. Critics worry that genetic discrimination could occur.

The troublesome fact remains, however, that the line between genetic diseases and undesirable traits is blurred. Caplan cites the example of albinism, which is not a disease but is associated with a higher risk for skin cancer, faulty vision and social stigma. "I think the standard that medicine wants to go with is, is there clear dysfunction or disorder? If not, I would argue that medicine ought not to be testing for it and counseling for it. If we're in the gray zone, I suspect we should try to stay out of those areas, because there's so much else of clear value that we could be doing," he suggests.

Yet Caplan admits that—as much as he would like to—he cannot frame a convincing standard that would allow parents to select some of their children's traits but not their sex, height or other cosmetic features, presuming technological feasibility. Distaste for abortion will stop many parents from exercising that veto for now. But such choices could be circumvented by emerging technologies for screening embryos before they are implanted—or even before conception. "So I think the stance that we will deal only with clear-cut disorders will last about five minutes," Caplan answers ruefully. "Once you can actually do that testing, the interest will swamp my objections. The ability to choose the traits of your child will roar through with a whoosh."

The consequences of those choices may be very hard to predict. Murray recalls that at a meeting of the American Society for Human Genetics a few years ago, he heard about a deaf couple who had asked one geneticist whether the hearing ability of a fetus could be determined prenatally: they wanted to go through with the pregnancy only if they knew that the child *would* be deaf.

As Brittany Abshire and millions of other healthy children and adults prove, genetic testing can immeasurably improve the quality of life for individuals, even entire families. To ignore the good it can do would be an act of immoral blindness and cowardice. But using these technologies wisely will demand foresighted social and legal policies. The record is discouraging: in the past, when genetic discoveries have made tests possible, policymakers have often either encouraged them prematurely or acted too late.

"The paradigms of eugenics are programs of unsurpassed evil. They're not going to get any less evil just because our genetics got better," Murray muses. "We need to be very conscious of what we're dabbling in."

FURTHER READING

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