The Genetic Testing Controversy

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Genetic screening uses a variety of laboratory procedures to find out if a person has a genetic condition or disorder or is likely to develop a disease based on his or her genetic makeup. Individuals may wish to be tested if the family shows a history of one specific disease such as Huntington's Disease or breast cancer, if they show symptoms of a genetic disorder which could be improved by early diagnosis, or if they are planning a family and are concerned about the possibility of passing on a genetic trait to their offspring. This last type of screening can look at the parent's genotype or look at the genotype of the fetus or newborn. This type of screening can also look for a specific disorder or can be done as a general test for common disorders as in prenatal testing or more commonly newborn screening.

Genetic tests use techniques to examine genes or markers near the genes. Direct testing for diseases such as Cystic Fibrosis and Sickle Cell Anemia come from an analysis of an individual's specific genes. A technique called linkage analysis, or indirect testing, is used when the gene cannot be directly identified but can be located within a specific region of a chromosome. This testing requires additional DNA from an affected family member for comparison. Because each person's DNA is unique (except for identical twins), genetic tests also can be used for individual identification ("DNA fingerprinting"). This technique is often used in forensic work, where samples from a crime scene such as blood or semen could be used as incriminating or acquitting evidence.

Genetic testing is a complex process, and the results depend both on reliable laboratory procedures and an accurate translation of results. Tests also vary in sensitivity, that is, their ability to detect mutations or to detect all patients who have or will develop the disease. Interpretation of test results are often complex even for trained physicians and other health care specialists.

Types of Genetic Testing

Carrier Identification includes genetic tests used by couples whose families have a history of recessive genetic disorders and who are considering having children. Three common tests include those for cystic fibrosis, Tay-Sachs disease, and sickle-cell trait but more tests are coming on the market at a very high rate. Norman Frost of the University of Wisconsin Madison Medical School says, "Potential new genetic tests roll off the conveyor belt of the human genome project almost once a week " (2).

Preimplantation Genetic Diagnosis (PGD) combines recent advances in genetics with the well established techniques of in vitro fertilization (IVF). In IVF, a woman's monthly reproductive cycle is manipulated. She is given hormones that stimulate her ovaries so that many eggs mature at one time. The eggs are surgically collected and fertilized with her partner's sperm in a lab dish. The resulting embryos are then transferred to the women's uterus and, if all goes well, pregnancy begins (3).

In 1989, a couple by the names of Renee and David Abshile, who were both carriers of the disabling condition Tay-Sachs, lost a daughter to the lethal disease. Because Tay-Sachs is a recessive disorder, two carrier parents each have a 50% chance of donating an abnormal allele. This gives the newborn a 25% chance of procuring both recessive abnormal alleles, a very high risk when regarding humans.

According to a Scientific American report (2), the Abshiles promised they would never again have another child unless they could be sure it would not be predisposed to the disorder. The only way to be sure was to have a prenatal genetic test that would show whether or not the child would acquire the disorder based on its genetic makeup. This type of test has its obstacles in that if the fetus does have the abnormal genetic makeup, the only way to stop it is to abort the fetus. Abortion was not an option for the Abshiles because of strong religious beliefs.

The Abshiles were out of luck until they heard of a new procedure of genetic testing called preimplantation genetic diagnosis (PGD) in which fertilization is done in vitro (IVF) and the cells are grown to a multicell stage and then tested for the genetic mutation/malfunction.

In the Abshile’s case, they were able to implant three pre-embryos that were not even carriers for the disease. From those three embryos came the first baby to be certified free of the Tay-Sachs disease.

Prenatal Diagnosis is genetic testing of a fetus. This may occur when there is a risk of bearing a child with genes associated with mental retardation or physical deterioration. Down Syndrome is one of the most common genetic diseases screened by this method.

Prenatal testing is probably the most controversial type of diagnosis because of the abortion issue. When do we draw the line on abnormalities? Is it ethical for parents to abort a child because the child will have Tay-Sachs disease or an even more ethically consuming question, is abortion okay if the child is not going to be the right sex?

According to the book Feminism and Bioethics: Beyond Reproduction, Korea is currently predicting a 10% increase in the male to female ratio within the next thirty years. Sex selection is illegal in Korea but doctors give unspoken results through the amount of enthusiasm they show the mothers. If the doctor lacks enthusiasm upon the test results, the mother often calls for an abortion, knowing that the fetus is a female (1)

Newborn Screening is frequently done as a preventative health measure. Tests usually have clear benefit to the newborn because treatment is available. Phenylketonuria and congenital hypo-thyroidism are conditions for which newborn testing is conducted in all 50
Late-onset Disorders include adult diseases such as Huntington's Disease, cancer and heart disease. Diseases like cancer and heart disease are complex and have both genetic and environmental causes. Genetic tests may indicate a susceptibility or predisposition for these diseases. Diseases like Huntington's disease, are caused by single genes that also are seen later in life. These types of disorders can be tested for at any time.

Recently through studying blood samples of families in which there is a history of breast cancer, scientists have isolated and identified a gene linked to breast cancer. In families with hereditary breast cancer, which accounts for less than ten percent of all cases, mutations in the BRCA1 gene confer an 85% lifetime risk of the disease, as well as a 45% chance of ovarian cancer. Some women in such families who have learned that they carry a mutated BRCA1 have elected to undergo Prophylactic mastectomy and oophorectomy (removal of the ovaries), a procedure that may reduce but does not eliminate the risk of cancer.

By being able to identify these genes through particular "markers" associated with the gene, doctors will know which individuals are more susceptible to cancer and therefore can follow the proper procedures to more effectively observe the individuals for signs of the disease. The earlier the doctor can diagnose the cancer the more effective the treatment will be.

Mass population testing is a large scale testing usually of a particular ethnic group that shows a high rate of a specific genetic disorder. This type of testing has been both successful and unsuccessful.

A voluntary genetic screening program was set up in the early 1970's for Tay-Sachs disease. It has been a huge success. More than a million Jews throughout the world, which Tay-Sachs predominantly affects, have volunteered to be tested to see if they were carriers of this genetic disorder. A carrier is not affected because to develop the disease symptoms, a person must carry two recessive alleles, one from each parent.

Before the people were tested they were educated as to what the tests would mean and what they could do with the information from the tests. Once they were tested, genetic counseling was available to answer any questions about the implications of the tests. This mass genetic test was a huge success, especially to Jews because it gives the individual the knowledge they needed to plan their family future.

About the same time as the Tay-Sachs testing was taking place, another ethnic minority group was being tested. This testing was for a different disorder with a very different response.

African Americans were being tested for the blood disorder sickle cell anemia. This mass testing was not as big a success as the Tay-Sacks testing for a number of reasons. The disease sickle cell anemia is a hereditary disease that affects the hemoglobin molecule. The result is a sickle shaped red blood cell which, in the absence of oxygen, clumps. The two alleles for sickle cell are codominant and a heterozygous individual (Ss) produces both normal and sickle shaped blood cells. People homozygous for the sickle cell allele rarely make it to reproduce.

The screening was done by an easy-to-administer blood test that could be given by anyone, including clergymen and local community volunteers. The test checks for carriers who will have some sickle cell RBC and some normal. Where the test was faulty was the lack of education that went along with the tests. Massachusetts required African American children at risk for sickle cell to be tested before entering school and soon the people carrying a single allele were thought to be diseased even though there were no outward manifestations of the disorder.

To add fuel to the fire, scientists suggested that the solution was for blacks carrying the allele to forego breeding. This sent a message that the screening was a eugenics attempt by the federal government (who funded the program) to eliminate the African American community (2).

Even though this mass testing started out with the best of intentions for the African American community, it ended in disaster because of poor planning. Because of the implications that could and do arise from mass genetic testing, it is a volatile issue and needs to be approached most delicately and tactfully.

Individual Identification can be used in areas ranging as widely as forensic testing to paternity testing. In these cases a "DNA fingerprint" is used to compare two different individuals or samples to see how closely they match. The O.J. Simpson trial is a well known example of individual identification where a blood sample was found and matched to the accused.

It is also possible to do individual identification testing in a prenatal fashion as will be described in the following scenario provided by the U.C. Berkeley program in Genetic Counseling and Georgetown University Medical Center. The scenario is based on an actual situation. Mr. and Mrs. C. come to a genetics clinic for prenatal diagnosis. Both are carriers of one cystic fibrosis allele. Cystic fibrosis is a lung disorder which causes a mucous buildup and prevents proper breathing. Mrs. C, who is pregnant, undergoes the prenatal test. The results that come back show the fetus having two abnormal cystic fibrosis alleles, but with a small twist of gargantuan proportions. Much to the dismay of the doctor, one of the mutations that the baby carries is different from that of the mother or the father, making it virtually certain that Mr. C is not the father. This scenario shows both an example of prenatal testing, but more importantly, individual identification.

Conclusion on genetic testing

Genetic testing is not a single technology. Rather, it refers to a broad range of methods for gauging the presence, absence or activity of
Genetic testing can cost less than $50 for a simple blood screening for sickle cell or cost in the $10,000 range for a complicated preimplantation genetic test for Tay Sachs disease. These are two extremes of genetic tests with varying costs.

Real and conceivable controversies

Genetic screening has great potential for our society. It has the capability of improving and lengthening human life. If used in an ethical manner, genetic testing can eliminate unforeseen suffering and distress. But, issues such as privacy, consent, discrimination, equity, and social engineering are potential barriers that many individuals have confronted already. Both legal and personal family conflicts may arise because of testing of individuals or immediate relatives.

Privacy

What about privacy? Does it really exist? Should it exist? How can we ensure that it does? These questions and more are being studied by researchers in order to make genetic screening as promising a technology for improving human health and longevity as possible.

The Alliance of Genetic Support Groups, in Chevy Chase, MD says that, "information learned about you or your family through your participation in genetic research can become known to persons other than the research team." (5) This is incriminating evidence for the lack of genetic privacy.

Should others have access to your genetic records? According to a nationwide Time/CNN poll, 90% of respondents thought it should be illegal for insurance companies to use genetic tests to decide whom to insure. But regardless of public opinion, a 1992 congressional study revealed that underwriters at 11 of 25 Blue Cross/Blue Shield plans said they would turn down an applicant if pre-symptomatic testing discovered likelihood of a disease. (6)

Genetic Privacy can also bring up other issues like who has the right to know? Because your genes are not exclusively our own (you share your genes with your parents and siblings), do you have a moral obligation to tell potentially affected individuals. Is it important whether the effect is direct or indirect? A 1992 March of Dimes poll showed that 98% of those polled thought a spouse or betrothed should know about a defective gene. (4)

If for instance you find through genetic testing that you are carrying two BRCA1 dysfunctional alleles for breast cancer, this means your mother also carries the gene and is at risk. If you carry two alleles your female siblings also are at a potential risk. What if you don't tell anyone? Does your doctor have the ethical obligation to tell your family members that could be affected? Should this be a legal obligation?

In a poll of doctors, 54% said that even over a patient's objections, they would tell relatives at risk about the results of a test from Huntington's Disease. 24% said they would tell a patient's employer and 12% said they would tell an insurance company. (4) This makes the privacy issue a bit more perplexing.

Consent

Do individuals have the right not to know? This has been a question that the Federal government has been toying with, but so far has left up to individual states to regulate. Many states have proposed legislation similar to the one proposed by Indiana in 1997. This legislation would prohibit insurance companies from forcing people to be tested in order to be insured and would also prohibit inquiries into the results regarding genetic screening or testing (9). But is it possible to stop all inquiries into genetic testing? Insurance companies have the right to look at medical records and family histories before granting coverage and indirect or direct genetic results could be obtained from these records. Unfortunately, these are all questions that will inevitably be answered in our court systems.

Discrimination

Discrimination could be a nightmare to someone with a genetic disorder or to someone with a family history of genetic disorders. A study done at Georgetown University looked at the perceptions of 332 members of genetic support groups and found that 25% of respondents of affected family members believed they were refused life insurance. 22% believed they were refused health insurance and 13% believed they were denied or let go from a job due to a disclosure of confidential genetics testing results. (7) Many doctors have indicated that people will get genetic testing done anonymously or under false names in order to avoid potentially discriminating situations (4).

Even if a genetic test is not done, discrimination based on possible gene makeup can still take place. One woman who applied to become an adoptive parent was denied because a family history of Huntington's disease made her a high risk (2).

In another case, a family's HMO learned of a prenatal genetic test showing that the fetus carried two recessive alleles for Cystic Fibrosis. When the HMO learned that they were going to continue with the pregnancy the family was informed that if the pregnancy was not terminated, movement to withdraw or limit the entire family's health coverage would result. This was the case until threats of lawsuits from the family encouraged the HMO to change their minds (2).

Equity
is genetic testing equally available to all? Will the rich be able to alienate itself from all genetic problems creating a lower class of outcasts? Before the start of the Human Genome Project, genetic abnormalities spanned all socioeconomic classes with similar percentages. This is no longer the case.

If gene patenting is allowed to proceed, the cost of genetic tests could skyrocket based on demand. This could lead to only the wealthy being able to afford genetic testing and from this, genetic problems could be isolated to the poor.

Social Engineering

Leon Kass makes excellent sense in the following statement, "I was conceived after antibiotics yet before amniocentesis, late enough to have benefitted from medicine's ability to prevent and control fatal infectious diseases, yet early enough to have escaped from medicine's ability to prevent me from living to suffer from genetic diseases. To be sure, my genetic vices are, as far as I know them, rather modest, taken individually -myopia, asthma and other allergies, bilateral forefoot adduction, bowleggedness and pessimism, plus some four to eight as yet undiagnosed recessive lethal genes in the heterozygous condition-but taken together, if diagnosable prenatally, I might never have made it." (10)

But is preimplantation testing, that looks for desirable traits, all bad? Is it wrong for a parent to desire to choose the best traits in its soon-to-be offspring? Some critics say it would give the parents a more enthusiastic role in conceiving a child if they had some control over its beginnings.

Are we out to make the perfect child? It may seem farfetched now, but what if we could? Will we ever have the technology to make a human more intelligent? This may only be a pipedream. As geneticist Eric Lander puts it, "We can tinker at the edges, but we are talking about an understanding of single components in a system that has 100,000 components." As long as that's the case, the best way to produce smarter kids is to educate them (11). But, when it comes to humans, who knows what we will try to do.

Conclusion

All of this discussion and debate ultimately stems from the Human Genome Project. This project is an international effort to map and sequence all the genes of the human cell. The project has allocated a large amount of its funds, some $40 million, to the ethical, legal and social implications (ELSI) of genetic research. This allocation has created many social, legal, and hard science studies. These studies included the production of a widely accepted set of principles to guard against genetic discrimination, insuring quality in DNA labs, educating doctors in the use of genetic data, and guiding researchers on obtaining informed consent.

Many of the issues that are controversial with the system revolving around genetic testing can be prevented with foresighted social and legal policies, health care reform, and state and national legislation. But European countries with universal health care and national legislation still have problems with discrimination and privacy.

Do we eliminate the most extensive technology ever known to man or do we do our best to improve on the mistakes we have made and create a better world for the future? In order to improve on anything, a risk must be taken. It would be cowardly to obliterate the potential good from this endeavor. With this in mind, I am reminded of my favorite quote by probably the most famous scientist of all time, Albert Einstein.

"Great spirits have always encountered violent opposition from mediocre minds"

As a conclusion I can not say it any better than Tom Dworetzky (8). "I'm not saying we shouldn't proceed with the Human Genome Project. The gifts it will bear in treatment for devastating inherited diseases outweigh its societal risks. However, we must begin, individually and collectively, to prepare for this knowledge by addressing our prejudices. Those are the most deadly of all inherited diseases, ones we must cure before our genetic knowledge will ever flower into wisdom and we truly become human beings."

References

9. Digest of introduced bill affecting Indiana code 27-4-1-4 ; 27-8-25. effective July 1, 1997