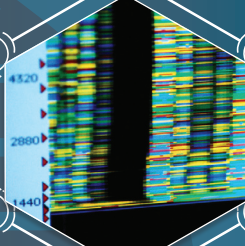
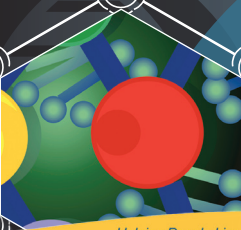


NEBRASKA Patient Education About Genetic Testing

Nebraska informed consent booklet

September, 2016



- 
- 1 WHAT IS GENETICS?
 - 2 WHAT IS A GENETIC TEST?
 - 2 WHAT HAPPENS DURING A GENETIC TEST?
 - 3 WHAT MIGHT I LEARN FROM A GENETIC TEST? WHAT ARE SOME BENEFITS?
 - 3 WHAT ARE SOME LIMITS OF GENETIC TESTING? WHAT RISKS ARE THERE?
 - 5 WHAT DO THE RESULTS MEAN?
 - 6 WHAT OTHER CHOICES DO I HAVE?
 - 6 WILL YOU PROTECT MY PRIVACY?
 - 6 WHAT ABOUT THE PRIVACY OF MY RELATIVES?
 - 6 WHAT WILL HAPPEN TO MY SAMPLE?
 - 6 WHAT IF I CHANGE MY MIND?
 - 7 TYPES OF GENETIC TESTS
 - 8 DICTIONARY



If you are thinking about having a genetic test, this book can help you make a choice. It explains different kinds of genetic tests. It tells about things we can learn from genetic tests, and things we cannot learn. It gives some reasons you might want to be tested, and some reasons you might not want to be tested right now.

If you decide to have a genetic test, you will sign a paper called an Informed Consent form. You will be given a copy of the Informed Consent form, and you will be given a copy of this book. Keep them together so you can find them if you have questions later.

Nebraska law says that people who have certain kinds of genetic tests need to be told certain things about the tests. This book and the informed consent form cover those things. The book and the form were written by the Nebraska Department of Health and Human Services. You can go to <website> to get more copies, and get more information.

You may have a lot of questions about the genetic test, what the results might mean, and how testing could help or not help you. Talk with your health care worker about your questions. Keep asking more questions until you are sure what you want to do.

What is Genetics?

Genetics (*jen-net-iks*) is the study of how our bodies work, and how we pass certain things from parent to child. We have two sets of genes (jeenz), one set from our mother and one set from our father. Each gene does something special. Some genes shape our faces. Some genes color our hair and eyes and skin. Some genes help us stay healthy, and some genes can cause harm if they are damaged.

Harmful gene changes may happen for the first time in a baby, or they may be passed from parent to child. Sometimes one harmful change in one gene will cause a genetic condition. Sometimes a genetic condition happens because many genes are missing or damaged. Some genetic health problems show up right away. Some do not show up for many years.

What is a genetic test?

A genetic test tries to find out if a gene is working as it should. Some tests look at the genes themselves to see if they are correct. Some tests look at

the “products” or substances the genes should be making. Some tests look at hundreds or thousands of genes at the same time. [The section on page 7 at the back of this book talks about different kinds of tests in more detail.](#)



Genetic tests can be done on small samples from the person’s body. Most tests use blood, skin brushed from the inside of a person’s cheek, or a sample from a pregnancy.

What happens during a genetic test?

You will talk to a health worker about the reasons for having a genetic test. You will talk about other choices besides having a genetic test, including doing nothing. You will talk about what you want to learn from testing, and decide what kind of testing is best for you.

If there is a chance the test will show extra information apart from the answers you are looking for, you will talk about this. You will decide whether or not you want this extra information to be shown in the test results.

The genetic sample will be taken. Your health care worker will tell you how this will be done, and tell you about any risks from taking the sample.

Your genes or gene products will be taken from the sample.

- If you are having [targeted testing](#), the test will look only at one part of one pair of genes. The test will show whether you have two normal parts, two damaged parts, or one normal and one damaged part. It is important to remember that only one very small part of the gene is tested. There could be damage somewhere else in the gene, and this test would not show it.
- If you are having [microarray](#) or [array testing](#), your genetic sample will be spread on a plate of carefully chosen genes or bits of genes. The results are put through a machine that tells which if any bits are missing or if there is extra genetic material that can cause harmful changes. You will not learn anything about genes that are not on the array or panel.
- If you are having [gene sequencing](#) or a panel of genes sequenced, your genetic information will be put through a machine that “reads” the genes. The spelling of your genes will be compared to the usual spelling. The spelling of your genes will be compared to genes that have harmful changes. The information you will learn depends on how many of your genes are sequenced.

- Sometimes there are problems with the sample, and the test has to be done again. This might happen because the sample was damaged in shipping or handling. Or sometimes there are problems with the testing itself. If this happens, your results may take longer.

Your health worker will tell you how long the testing will take. You and your health care worker will decide how you want to learn about the results. You could meet with your health care worker, or talk on the telephone, or get your results in the mail. Or you could do more than one of these things.

What might learn from a genetic test? What are some benefits?

You might find out why the person tested has certain health problems or learning problems. This could make it easier to get the right kinds of health care and services. It can be a relief to learn that a problem was caused by gene changes and not by something a person did or didn’t do.

If a genetic condition runs in your family, testing may show you don’t have the damaged gene that causes it. This means your chance of getting the condition is no greater than average. And it means you cannot pass that harmful gene to your children. If testing shows you do have the damaged gene, there may be steps you can take to keep your risk lower. And there may be steps you can take to keep from passing that gene to a child. You could discuss these with a health care worker and make choices based on what you think is right.

You might find out you are a “carrier” of a damaged gene that only causes harm when a child gets the same damaged gene from both parents. If you want to have children, your partner could get tested for the same gene. If you both carry a damaged gene for the same genetic condition, there are some ways to keep from passing both genes to a child. You could discuss these with a health care worker and make a choice based on what you think is right.

If you know the cause of a health problem you may be able to get better treatment for it. You may be able to join research studies. You may be able to plan ahead. You may be able to help other people in your family. But you may still have lots of questions the test results can’t answer.

What are some limits of genetic testing? What risks are there?

- [CHOOSING THE RIGHT TEST](#): It is important to use the right test for the questions you want to answer. To decide which test is best, your health care worker needs true and complete information about your health and your family’s health. The health care worker also needs true and complete information to figure out what the test results mean. Making health care decisions based on wrong information could be very harmful.
- [FINDING AN ANSWER](#): Even the best genetic test will not tell us everything about your genes. You may not get a clear ‘yes’ or ‘no’ answer. Or the test results may raise a lot of new questions. If we find a harmful gene change, we may not be able to say how it will affect the person. If we don’t find any harmful gene changes, we may not be sure what that means. Maybe the person doesn’t have a genetic problem. Or maybe the problem is in a gene we haven’t found yet.
- [UNDERSTANDING WHAT THE TEST MEANS](#): Our understanding of genes is always changing. As we learn more about genes, we may find that something we call normal today is really not normal. And something we

call harmful today is really not harmful. You may make serious health care decisions based on what you are told after your testing. And you may find out later that our understanding has changed. You should check with your doctor from time to time to make sure your information is up to date.

- **FINDING OTHER CONDITIONS:** We could find a harmful gene change that has nothing to do with the reason you are having this test. You could have a higher risk for a disease that won't happen for many years. Some people don't want this kind of information.
- **FAMILY MEMBERS AT RISK:** If we find a harmful gene change in you, then other people in your family might also carry the same change. Sometimes it is hard to share this information, or your relatives might not want to know about it. You will be able to talk about this with your health care worker.
- **FINDING CARRIER STATUS:** We could find out that you carry a gene change that won't cause problems for you, but it could cause problems if a child gets the same harmful gene change from both parents.
- **NEED FOR MORE TESTING:** Sometimes we find a gene change and we're not sure if it is harmful, so we want more tests. Sometimes to understand your own results we need to test other people in your family. You will be able to talk about your results and choices with your health care worker. We will not share your results with anyone else in your family without your permission.
- **CHANGES IN FAMILY TREE:** If we test more than one person in a family, we might learn that family members are not related to each other in the way they thought they were. The gene tests might show that a child has a different father, or that donor eggs or sperm were used for a pregnancy, or that a child was adopted. This news could cause strong feelings in some families. You will be able to talk about this with your health care worker. We will not share your information with anyone else in your family without your permission.
- **SHARED GENES:** Usually people get slightly different genes from their mothers and fathers. Some genetic tests may show that the mother and father are close relatives, or that the person is from a small community where all the families came from the same roots.
- **PRIVACY:** Your test results will be in your medical records. Some people worry that genetic information could be used against them. It is against U.S. law to deny someone a job because of health information. It is against U.S. law to deny someone health insurance, or raise the cost, because of health information.



It is legal to use this information to deny or raise the cost of life insurance and disability insurance.

- **DAILY LIFE:** Deciding to have genetic testing can cause a lot of stress. The test results may not show what you expected. Even if you are not surprised, you may still have strong reactions. You may find it hard to think about anything else for a while. The information might change how you think about yourself, and it might change how others think about you. It could affect your family life. Talking to a health care worker can help you deal with these feelings.

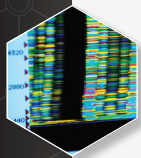
What do the results mean?

Medical words may not mean what you think they do. Be sure you ask your health care worker to explain what your test results mean.

Many test results are reported as "positive" (something abnormal was found) or "negative" (nothing abnormal was found). In genetics, results can also be reported as "uncertain" or "inconclusive."



- **POSITIVE (abnormal):** the test shows a gene change that has been linked to a genetic condition or disease. Most gene changes are found by studying people who show physical features of the condition. If they all have changes in the same gene, then that gene probably is the cause of the condition. But as we learn more, we sometimes find people with changes in that same gene who do not have any features of the condition. Or we sometimes find people with the genetic condition or disease who don't have any changes in that gene. And two people with the same gene change may have very different health problems, even in the same family.
- **NEGATIVE (normal):** the test did not show any gene changes linked to a genetic condition or disease. This could be because the person truly does not have a damaged gene. We have the greatest trust in a normal result when there is only one gene that causes the condition. Or when we know exactly which damaged gene runs in a family. For other people, a negative result could mean that the person has damage in a different gene that no one has discovered yet. Sometimes more testing can help. Sometimes you just have to wait until the experts learn more.



- **UNCERTAIN, INCONCLUSIVE, INDETERMINATE, VUS** (variant of uncertain significance), **UCS** (uncertain clinical significance): the test shows a gene change, but we don't know whether the change is harmful. It could be a normal version of the gene. Before results are reported as uncertain, the testers will check to see if other people have found the same gene change in healthy people, or in people with a genetic condition. The testers will check to see what part of the gene carries the change. Some parts of a gene can be spelled in different ways without harm. Other parts have to be exactly right or they won't work. Some genes come in different lengths, and as these genes get longer, they get less and less stable. For these genes, "inconclusive" results mean that the gene is too long to be called normal, and too short to be called abnormal. We can't say for sure whether the person will get the disease or not.

What other choices do I have?

There may be more than one kind of test that can tell you the information you want. If this is an option you should choose the one that gives you what you need to know without giving you more than you want to know. You may decide not to have any testing right now. Tests will get better and cheaper in the future.

Will you protect my privacy?

In the U.S., permission in writing usually is needed before medical information is shared. This does not apply when the information cannot be linked to a person. The testing laboratory may keep your test results, without your name attached, for research. The laboratory may add your results to national or global databases, without your name attached, for research. None of this information will identify you.

What about the privacy of my relatives?

Parts of your genetic information are the same as the information for other people in your family. If you share your own genetic information, this might also affect the privacy of other family members.

What will happen to my sample?

When your testing is complete you may decide to have the laboratory destroy your sample. You might also decide to have the laboratory store your sample in case you want it for later testing. This will cost extra. You could also give the laboratory permission to remove all of your "protected health information" (PHI) (anything that could identify you), and use the sample for research.

Your decision about your leftover sample will not change the way the laboratory runs your test. It will not change the way you and your family get medical care. If you decide to let the laboratory use your sample and then change your mind, you may contact the laboratory and let it know. But if the laboratory has already removed all of your protected health information, it will not be able to destroy your sample because it will not know which sample is yours.

What if I change my mind?

If you sign the consent form and then decide that you don't want the test, you should contact your health care worker to cancel the test. If the test has already been done, you may still have to pay for it. Even if the testing has been finished, you can still tell your health care worker that you do not want to hear about the results.

TYPES OF GENETIC TESTS:

Chromosome test: (*kro-muh-zome*)

Chromosomes are the structures that carry genes and keep them organized. Extra or missing chromosomes, or parts of chromosomes, can cause problems. A picture of chromosomes from largest to smallest is called a **karyotype** (*care-ee-uh-type*).

Flourescence In-situ hybridization (FISH) test:

(*flor-es-since in-sit-tew hi-brid-uh-zay-shun*)
A chromosome test using small bits of genes that glow under special light. If the bits stick to the chromosomes, the matching genes are there. If the bits don't stick, those genes are missing.

Gene sequencing:

(*jeen see-kwen-sing*) looks for mistakes in the "spelling" of the gene. **Exon sequencing** (*ex-on*) looks only at the parts of the gene that make gene products. These are called the **coding regions** (*ko-ding ree-junz*). Most of the harmful gene changes happen there. **Whole gene sequencing** also looks at the **introns** (*in-tronz*) between the coding regions. Changes in those areas are less likely to cause problems, but sometimes they do.

Metabolic test:

(*met-tuh-bawl-ick*) Measures substances in the blood to

see if the person's genes are making the right kinds and amounts of gene products. An example is PKU or **phenylketonuria** (*fee-nil-key-toe-noor-re-uh*). A PKU test is done on every baby born in Nebraska.

Microarray testing:

(*my-kro uh-ray*) measures how many copies of genetic material is present to see whether the person's body has too much or not enough of something it needs. These tests are sometimes called CGH or **Comparative Genomic Hybridization**: (*kum-pair-uh-tive jean-oh-mick hi-brid-uh-zay-shun*). There are arrays for birth defects, slow learning, and others. The genes on the arrays may change from time to time. They might be different from testing company to testing company.

Targeted mutation

analysis: (*tar-get-ted mew-tay-shun uh-naa-lis-sis*) Looks for a certain gene change in a certain gene, that we know can cause problems. An example is sickle cell anemia. This kind of test also can be used when one person in a family has a gene change and other relatives want to know if they have the same gene change.

Targeted Next Generation Sequencing Panels:

(*tar-get-ted next gen-ur-ray-shun see-kwen-sing pan-nilz*)

look for spelling mistakes in a group of genes that can cause a certain kind of health problem. There are panels for deafness, cancer, heart problems, and many others. The genes on the panels may change from time to time. They might be different from testing company to testing company.

Whole Exome

Sequencing: (*hole ex-ome see-kwen-sing*) looks for spelling mistakes in almost all of the coding regions (exons) of a person's genes at the same time. This test will show lots of genetic information. You will talk to your health care worker about what kinds of information you want to know. This test will also show lots of "variants." We don't yet know whether these "variants" are normal or harmful.

Whole Genome

Sequencing: (*hole jeen-ome see-kwen-sing*) looks for spelling mistakes in almost all of the person's genes at the same time. This test will look at about 95% of a person's genetic information. You will talk to your health care worker about what kinds of information you want to know. This test will also show lots of "variants." We don't yet know whether these variants are normal or harmful.

DICTIONARY

Amniocentesis: (*am-nee-yo-sen-tee-sis*) a test that uses a long, thin needle to take a sample of amniotic fluid during pregnancy. **Amniotic fluid** (*am-nee-yot-tic floo-wid*) is the water around a developing baby in the womb. This fluid contains genes and gene products. It can be tested to learn more about the health of the developing baby.

Birth defect: a problem with a person's body or brain, that begins before the person is born. An example is cleft lip (the person's upper lip doesn't come together).

Carrier: a person who has one normal gene and one damaged gene from a pair where it takes two damaged genes to have health problems. This person will not have health problems. But the person's child could have health problems if two carriers have children together and they both give their damaged gene to the child.

Cell: (*sell*) the small units that make up our bodies. Cells contain genes, gene products, and other things we need to stay alive.

Chorionic villus sampling: (*kor-ree-yon-nik vil-lis sam-pling*) a test that uses a long, thin needle or tube to take a sample of the **placenta** (*pluh-sent-uh*) during pregnancy. The chorionic

villi (*vil-eye*) have the same genes and gene products as the developing baby.

Chromosomes: (*kro-muh-zomz*) the structures inside our cells that carry genes and keep them organized. Most people have 46 chromosomes.

Diagnostic testing: (*dye-ug-naws-tick*) a test that shows us if a person has a specific condition or disease. Usually a test is called "diagnostic" if the person already has some physical or mental signs of the condition before the test is done. The test helps us be sure which condition you have. Nebraska law does NOT require informed consent in writing before a person has a diagnostic genetic test.

DNA (deoxyribonucleic acid): (*Dee-en-nay*) the chemicals that form our genes. There are four small DNA chemicals called Adenine, Cytosine, Thymine and Guanine. They make long chains. The order of the chemicals in the chains determines what the gene will do, kind of like the order of letters in a sentence.

DNA banking: freezing a person's gene sample so it can be used later.

Embryo: (*em-bree-yo*) a developing baby during the first two months after the egg is fertilized.

Fetus: (*fee-tuss*) a developing baby from two months until the end of pregnancy.

Gene: (*jeen*) a stretch of DNA that tells the body to make something or do something special. Humans have about 24,000 genes.

Gene product: something the body makes using instructions from a gene. Gene products include proteins (the "building blocks" of the body), enzymes and hormones (chemicals that help the body run), and antibodies (chemicals that fight infection).

Genetic: (*jen-net-tick*) something about us that is caused or controlled by our genes.

Genetic counseling: (*kown-suh-ling*) talking with a health care worker about your health or your family's health to learn more about your genes. This may include talking about what tests can and cannot show. It may include talking about what to expect if you have a genetic condition, and what treatments you could use. It may include talking about children, or testing during pregnancy. Genetic counseling doesn't tell you what to do. It tells you about your choices, and helps you make choices that are right for you.

DICTIONARY

Informed consent: (*in-formd kun-sent*) You learn about the risks and benefits of a test or treatment, you think it over, and you decide that you want to have the test or treatment.

Informed refusal: (*ree-few-zul*) You learn about the risks and benefits of a test or treatment, you think it over, and you decide that you don't want to have the test or treatment at this time.

Predictive testing: (*pree-dict-tiv*) a test for a genetic disease or condition, done when the person has NO physical or mental signs of that disease or condition. The test results give us a better idea about whether the person will get the genetic disease or condition in the future. Nebraska law says when this kind of test is done, the person (or the person's parent) has to give consent in writing. Here is how Nebraska law defines predictive testing:

Neb Rev Stat 71-551(6)(c)

Predictive genetic test means a genetic test for an otherwise undetectable genotype of karyotype relating to the risk for developing a genetically related disease or disability, the results of which can be used to substitute a patient's prior risk based on population data or family history with a risk based on genotype or karyotype. Predictive genetic test does not include diagnostic testing conducted on a person exhibiting clinical signs or symptoms of a possible genetic condition. Predictive genetic testing does not include gamete testing, preimplantation diagnosis, or prenatal genetic diagnosis, unless the prenatal testing is conducted for an adult-onset condition not expected to cause clinical signs or symptoms before the age of majority.

Preimplantation testing: (*pree-im-plan-tay-shun*) genetic tests done on a fertilized egg before it is put in the womb. This requires special doctors and equipment.

Prenatal screening: (*pree-nay-tul skree-ning*) early tests done during pregnancy to see if more specialized testing may be needed. The screening test may or may not mean that the developing baby has problems.

Prenatal testing: diagnostic tests done during pregnancy to see if a developing baby has problems.

RNA (ribonucleic acid): (*are-en-nay*) the chemicals that help the body make gene products from genes. There are four small RNA chemicals called Adenine, Cytosine, Thymine and Uracil. They copy the DNA chains into RNA chains, then turn them into proteins or other gene products. Some tests measure RNA instead of

DNA, to see if the body is making the right type and number of RNA copies.

Screening: (*skree-ning*) tests done on lots of people to see who may need specialized testing. Screening results typically inform a person if they have a higher or lower chance of having a problem. Screening tests are not diagnostic.

We are indebted to and wish to acknowledge the members of a Nebraska genetics working group who collaborated to draft the Nebraska informed consent form and information booklet: Rebecca R Anderson JD MS, Kristen Larsen, Julie Luedtke, Richard E Lutz MD, Shelly D Nielsen MS, Ann Haskins Olney MD, Gwen M Reiser MS, Bronson Riley MS, Lois J Starr MD.

We are also indebted to the members of a national genetics working group who collaborated to draft user-friendly informed consent templates: Jodi D. Hoffman MD, Komal Bajaj MD, Robert G Best MD, Susan Gross MD, Julie R Jones PhD, Kelly E Ormond MS, Sue Richards PhD, Richard Sharp MD, Elaine Spector PhD, Rebecca R Anders JD MS.

We are also indebted to the members of the Michigan working group who developed one of the first model consent forms and information booklets for predictive genetic testing.

This project was supported by the Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (HHS) under grant number B04MC28111 Title V/Maternal & Child Health Services Block Grant Program for \$560,937.27 in Federal Fiscal Year 15, and B94NC39525 Title V/Maternal & Child Health Services Block Grant Program for \$814,650 in Federal Fiscal Year 17 with zero percent financed with nongovernmental sources. This information or content and conclusions are those of the author and should not be construed as the official position or policy of, nor should any endorsements be inferred by HRSA, HHS or the U.S. Government.

NEBRASKA

Good Life. Great Mission.

DEPT. OF HEALTH AND HUMAN SERVICES