Genetic Counseling & Testing

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What will you hear today?

• Description of genetic counseling & genetic counselors

• Description of a “typical” genetic counseling appointment

• Discussion of genetic testing
  • When is it appropriate & useful?
  • What are some of the benefits & limitations?
  • Answers to some FAQs

• One family’s story
Genetic counseling
What is genetic counseling?

• **Service that helps patients understand:**
  
  • How a person’s family health history can change his/her chance of inheriting a medical condition
  
  • How certain conditions are inherited
  
  • What genetic testing is available to & appropriate for a person
  
  • What genetic test results could mean to a patient & his/her family members
    • Parents, siblings, children, aunts/uncles, cousins...
Who are genetic counselors?

- **Professional requirements:**
  - Master’s of Science in genetic counseling / medical genetics
    - 2 – 3 year, full-time program with thesis requirement
  - Board certification (American Board of Genetic Counseling or ABGC)
  - Licensure (required in Indiana – not required in all states!)

- **Where do genetic counselors work?**
  - Several different types of clinics (prenatal, cancer, pediatric, adult, cardiovascular, etc.)
    - Typically within a hospital setting
  - Commercial laboratories that perform genetic testing
  - Private practice
The “typical” genetic counseling appointment
Why might a person be referred for genetic counseling?

• **Two main reasons:**
  
  • Person has been diagnosed with a condition that can be inherited
  
  • Person’s doctor may have noticed at least one “red flag” of a specific inherited condition in that person’s medical and/or family histories
For example...cardiovascular genetic counseling

• **Two most common categories:**
  • Cardiomyopathies
    • Heart muscle becomes stiff, enlarged, dilated, or replaced with fat or another protein
  • **Arrhythmias**
    • Conditions where a person’s heart beat (or heart rhythm) is abnormal

• **Important:** Not every person has an *inherited* condition!
  • Can also be acquired due to:
    • Certain drugs / medications
    • Damage to the heart muscle (e.g., from a heart attack)
    • Other causes
“Red flags” in a family history

• History of sudden death
  • Includes unexplained accidental death (drowning, single-car accidents)
  • Especially important if family member(s) died before age 50!

• Heart disease / congestive heart failure at a young age

• 2+ close relatives (on same side of family) with a cardiovascular condition

• Personal / family history of fainting or passing out
Once a patient is referred for genetic counseling, genetic counselor will:

- Collect & review medical records, imaging studies, autopsy reports, genetic testing results from patient/relative(s)
- Contact patient directly to schedule appointment & answer questions
- Send appointment reminder & family history form to patient
During genetic counseling appointment

- **Average length of genetic counseling appointment:** 1 ½ - 2 hours

- **Majority of time spent educating patient & relatives**

  - What is your family’s condition? What causes it?
  
  - How does this condition pass through families?
  
  - Which family members are at risk of inheriting this condition?
    - What screening recommendations are available for at-risk relatives?
  
  - Informed consent for genetic testing (more on this in a bit)
After the appointment

- Counselor sends detailed letter to patient that summarizes entire discussion

- **If testing was ordered**: counselor will call patient when results available

- Genetic counselors serve as continued resources, even after an appointment
  - Answer questions
  - Coordinate genetic testing for at-risk relatives
  - Connect relatives in other areas to local genetic counselors
Genetic testing

...but first, a quick genetics lesson
DNA, genes, & chromosomes – what are they?

- **Cell**: A cell is the basic unit of life, composed of one large continuous DNA molecule.
- **Chromosomes**: Each chromosome is a segment of DNA that encodes proteins.
- **Gene**: A gene is a segment of DNA that encodes a protein product.
- **Protein**: A protein is a complex organic compound composed of hundreds or thousands of amino acids.

DNA consists of four types of nucleotides: Adenine (A), Thymine (T), Guanine (G), and Cytosine (C).
Normal chromosomes

Women

Men
Important caution about genetic testing...

- Not every person is a good candidate for genetic testing

  - Testing is *most useful* when we *start with someone who has already been diagnosed* with the family’s condition

- Genetic testing may not be recommended or available for certain conditions

  - Reasons: too many genes to test; environmental/other complicating factors
  - Results of genetic testing won’t change recommendations for at-risk relatives
Example of when genetic testing is **not** appropriate

- High blood pressure and/or high cholesterol
  
  - Hundreds, if not thousands, of genes involved in development of these condition
  
  - Environmental factors (diet, exercising, smoking...) can also influence development
  
  - Genetic testing is **not** currently recommended by national expert panels
    - Results won’t change recommendations for at-risk relatives
  
  - If you have a family history, make sure your siblings & children talk to their primary care provider!
How is genetic testing done?

- Historically, genes were tested one at a time
  - Insurance/patient billed for every test
  - Very time-consuming & **VERY** expensive!

- Most genetic testing now offered via **panels**
  - One blood sample → one laboratory → one test → one results report

- Time to get results varies, depending on what test(s) is/are ordered
  - 2 weeks – 3 months
Possible results of genetic testing

Positive

• Mutation found - protein not functioning
• Associated with an increased risk for condition
• Genetic testing offered to relatives to clarify risk

Negative

• No mutation identified
• Genetic testing not offered to relatives

Variant of uncertain significance (VUS)

• Genetic change found, but can’t say whether it causes condition

• It’s also possible that genetic testing could identify multiple mutations!
  • Includes any combination of disease-causing, benign, or VUS results
Does genetic testing always identify cause of family’s condition?

• Honest answer is: 
  

  • Genetic testing is extremely complicated
    • Not every condition is inherited

    • Multiple genes for each condition (e.g., 33 genes known to cause dilated cardiomyopathy)

    • Some patients have negative results, but probably still have an inherited condition
      • May have a mutation in a gene that hasn’t been identified yet
      • May have a mutation that can’t be detected with current testing technology

  • Variants of uncertain significance (VUS)
Cost & health insurance coverage

- Genetic testing is expensive
  - Cardiovascular genetic tests range from $2,000 - $8,000 per test

- Most health insurance companies provide some coverage
  - May require genetic counseling before testing is ordered
  - Most have guidelines that outline when a patient qualifies for genetic testing

- Most genetic laboratories have financial policies to limit potential out-of-pocket cost

- Most labs obtain insurance authorization & appeal rejected claims on patients’ behalf

- **Informed consent:** we discuss this information *before* anyone agrees to testing
Privacy of genetic information

• Genetic information covered by HIPAA & state privacy laws

• Genetic Information Nondiscrimination Act (GINA)
  • Prevents *health insurance* companies from using a patient’s genetic information to deny coverage, raise premiums, etc.
  • Exemptions:
    • Life, disability, & long-term care insurance
    • Military, federal employees, & people with health insurance through Indian Health Service or VA

• Privacy also discussed as part of informed consent

• Patients *always* have right to decline or postpone genetic testing
Wow!
That’s a lot of information!!
Genetic counseling & testing seem complex & confusing...
And expensive...
So why would anyone consider genetic counseling & testing?
You can help your family.
Goal of genetic counseling & testing

Find family members at risk* of condition so that they start screening and/or treatment before any symptoms develop.

*At-risk relatives have up to a 50% (or 1 in 2) chance of developing family’s condition
  • Risk varies, depending on family’s condition
How do we accomplish this goal?

• Start by offering genetic testing to patient, in hopes that testing will identify mutation (genetic cause of family’s condition)

• Cascade screening: Test other relatives for mutation identified in patient

• Start with patient’s parents, brothers/sisters, & children*
  • Expand genetic testing to nieces/nephews, aunts/uncles, cousins, etc. as needed

*We’ll talk more about genetic testing in children later!
The bottom line...

Genetic testing identifies mutation in patient

Screening / genetic testing for at-risk family members

**Positive**
- Highest risk of developing condition
- Continue screening / start treatment

**Negative**
- No longer have increased risk of developing condition
- No screening / treatment

**Better outcomes & better quality of life**
One family’s story
Dilated cardiomyopathy

• Seen in ~ 1/2,700 people

• Dilated = open or enlarged
  • Irreversible

• Symptoms of DCM may include:
  • Edema
  • Orthopnea (trouble breathing when lying down)
  • Difficulty breathing / shortness of breath
  • Dizziness
  • Fatigue
  • Arrhythmia (abnormal heartbeat)
  • Cardiac conduction abnormality (unusual electrical activity of the heart)

• No cure—focus on managing/treating symptoms
Mr. W

• 55-year-old man with dilated cardiomyopathy (DCM)
  • Diagnosed at age 50

• His son was diagnosed with DCM at age 22
  • Died at age 30 (~ 6 months after heart transplant)

• Other family members *presumed* to have DCM:
  • 2 siblings (both died in their 40s)
  • Mother
  • Father
  • Paternal grandmother
Mr. W’s story

• Mr. W came for genetic counseling & accepted genetic testing for DCM

• **Results:** variant of uncertain significance (VUS) in *RBM20*
  - *RBM20* mutations: Early-onset, severe DCM; high risk of sudden cardiac death
  - Novel mutation

• **At-risk relatives:** 2 daughters & 4 grandchildren
How would you feel if you were Mr. W?

Your genetic testing results didn’t provide useful information to help clarify your children’s or grandchildren’s risk of DCM.
What would you do if you were Mr. W’s daughter?

Dad’s genetic test found a “mutation,” but we can’t tell you whether this variant is what causes DCM in your family.

If you have testing, no matter what your results are, we can’t tell you with certainty what your risk is.
Mr. W’s daughters

- Daughters (ages 19 & 21) accepted genetic testing
  - Both negative

- What did these results mean for the daughters?
  - Risk of developing DCM was likely much lower, but...
  - We don’t know whether *RBM20* variant = genetic cause of Mr. W’s DCM

- **Bottom line:** Daughters still at 50% risk of developing DCM
  - Recommended cardiology screening
What about Mr. W’s grandchildren?

- All < 18 years old

- Genetic testing typically not performed on minors
  - Autonomy (each person has right to decide for himself/herself to pursue genetic testing)

- Rarely, genetic testing is recommended in children / adolescents
  - E.g., family history of childhood onset; sudden death in childhood
  - Long, detailed discussion with parents/children before testing is offered
Just one example of how complex genetic counseling & genetic testing can be!
Interested in genetic counseling?

- Talk with your primary care provider, cardiologist, oncologist, etc., & ask for a referral to Community’s genetic counselors.

- Community also has a “genetics hotline” available for anyone with questions about genetics, genetic testing, or family history.

*317-621-8988*

- Choose **option 1** for cancer genetics
- Choose **option 2** for cardiovascular genetics
- Choose **option 3** for prenatal genetics / Maternal-Fetal medicine
- Choose **option 4** for general genetics questions
Thank you!

I’ll be happy to answer a few questions...

...but we don’t have time to go over everyone’s family history!