Roxana Rhodes, MD

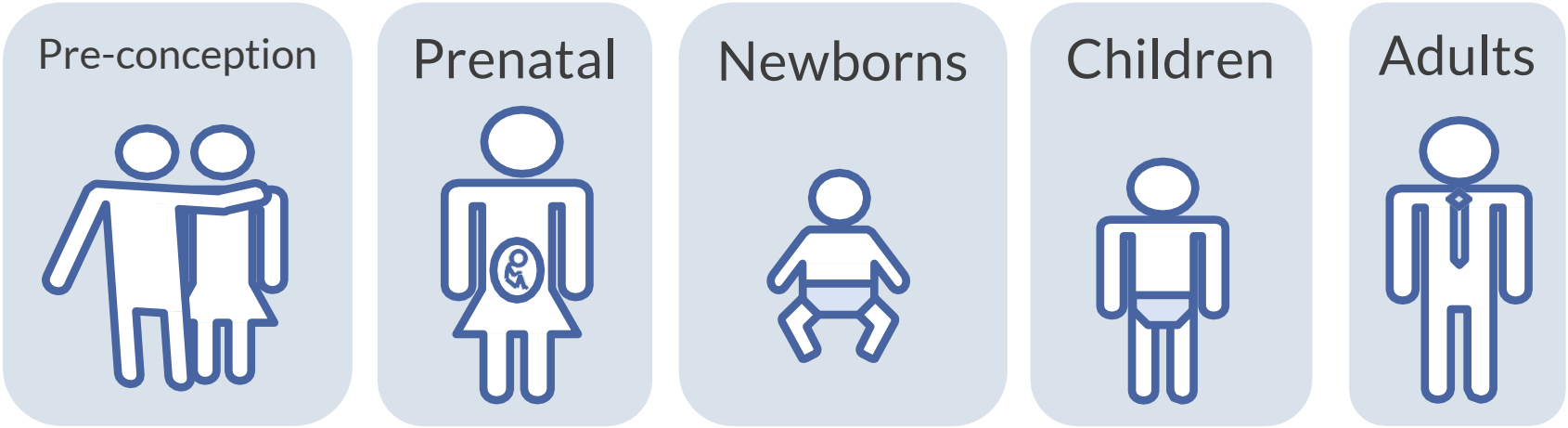
Partners in Health

Precision Genomic Medicine

Introduction

What is Precision Medicine?

- Managing patients based on their unique genetic profile, environment, and lifestyle
- Heavy focus on human genetics/genomics



Thank you to Dr. J. McCarthy of Precision Medicine Advisors for many of the graphics in this talk

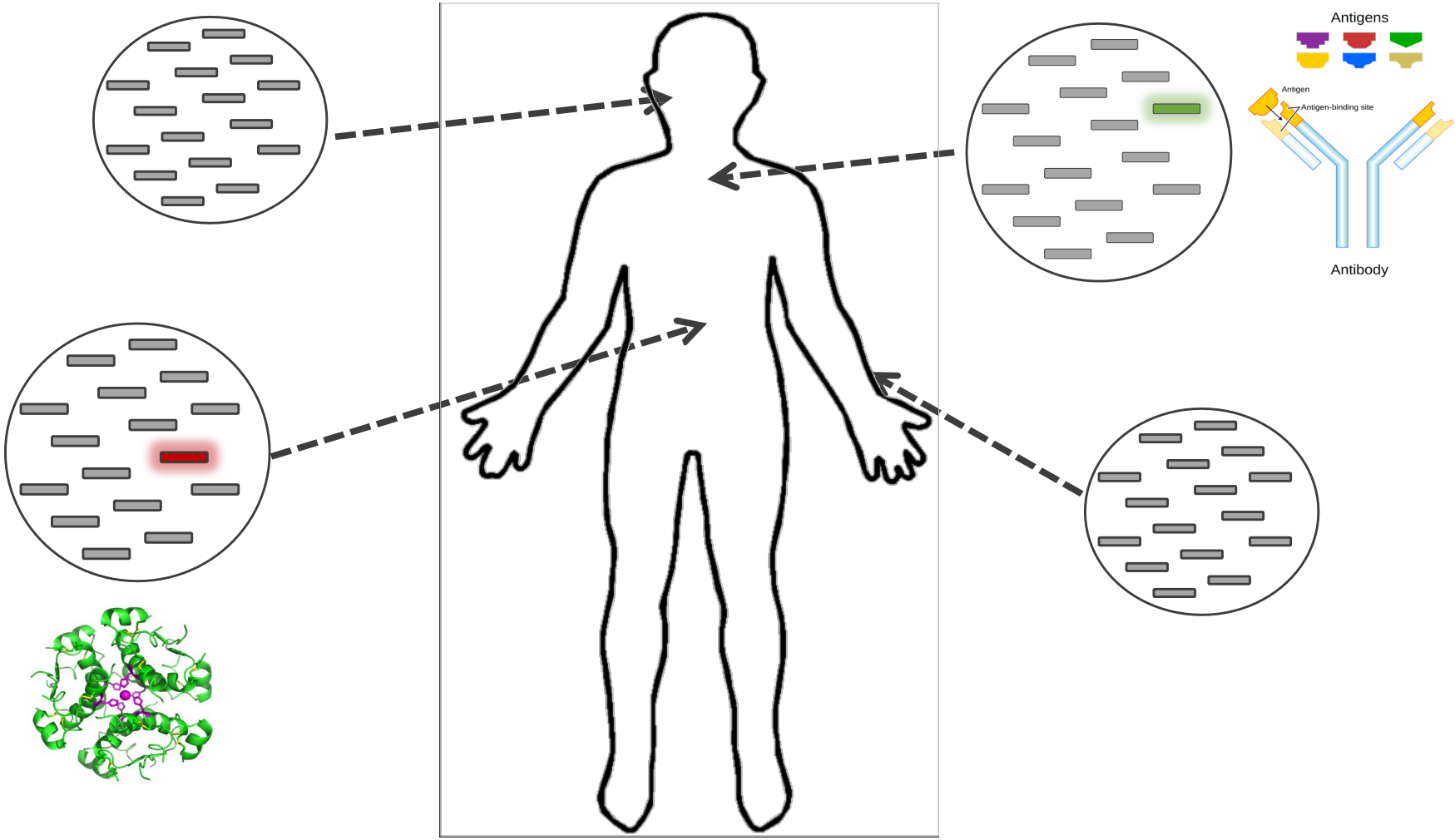
Facts

7% of all hospitalizations are due to an adverse drug reaction, increasing to 10-30% if you are over 65.

99% of people have a genetically indicated drug response

10% of us have genetics that may one day lead to a genetics-based disease.

Trillions of Cells, One Genome



Nucleotide building blocks A T G C

DNA 

DNA sequence:

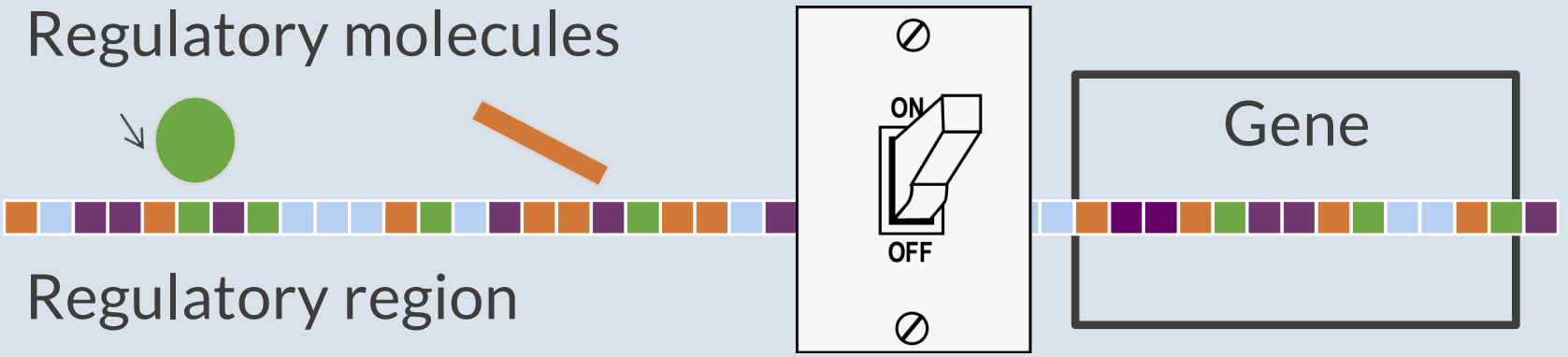
ATCGCCGGGCCTGGCGCCGCAGAGCACGAGAG

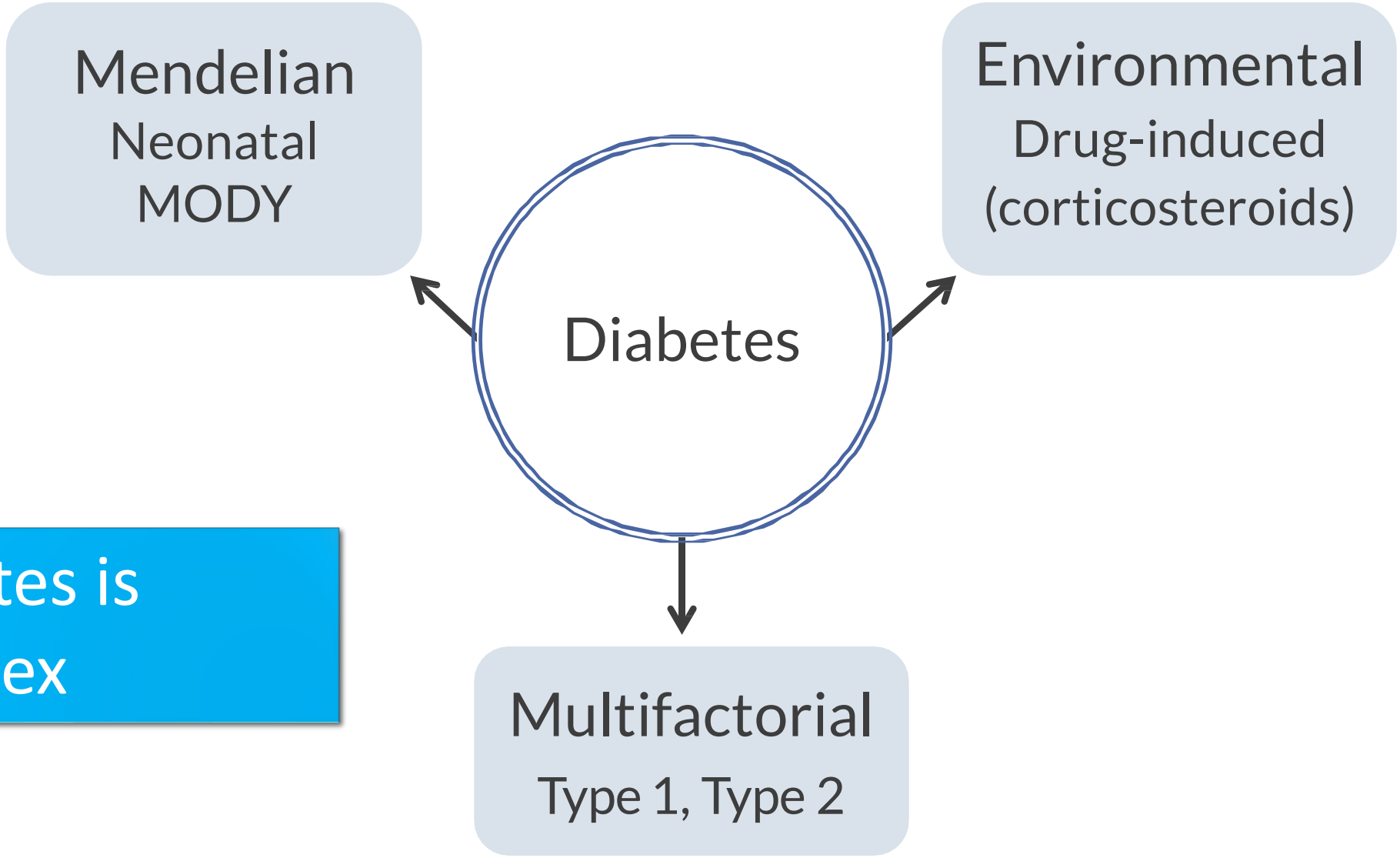
Size: 34 nucleotides (basepairs; bp)

Human genome size
3.2 billion bp

Environmental influences

The molecular level





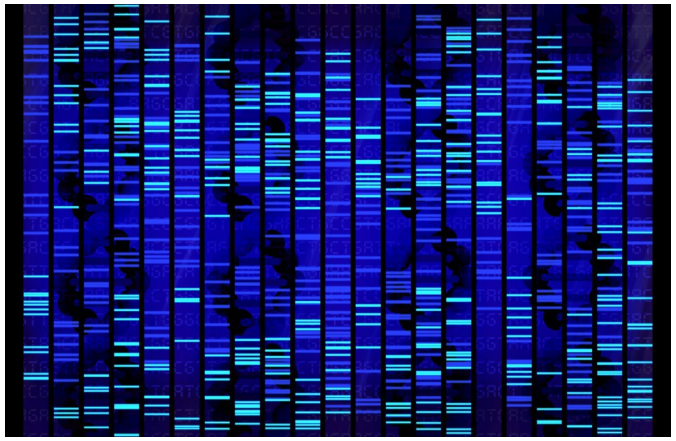
Diabetes is complex

Genetic Testing

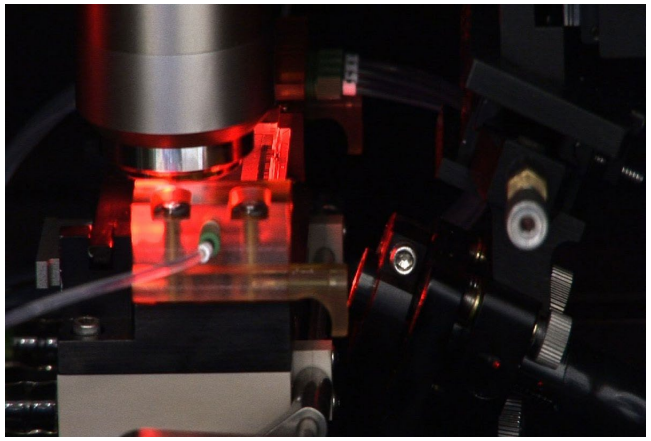
Brief History of Genetic Testing

1871 – Dr. Miescher discovers DNA

1953 - Watson and Crick discover the double Helix

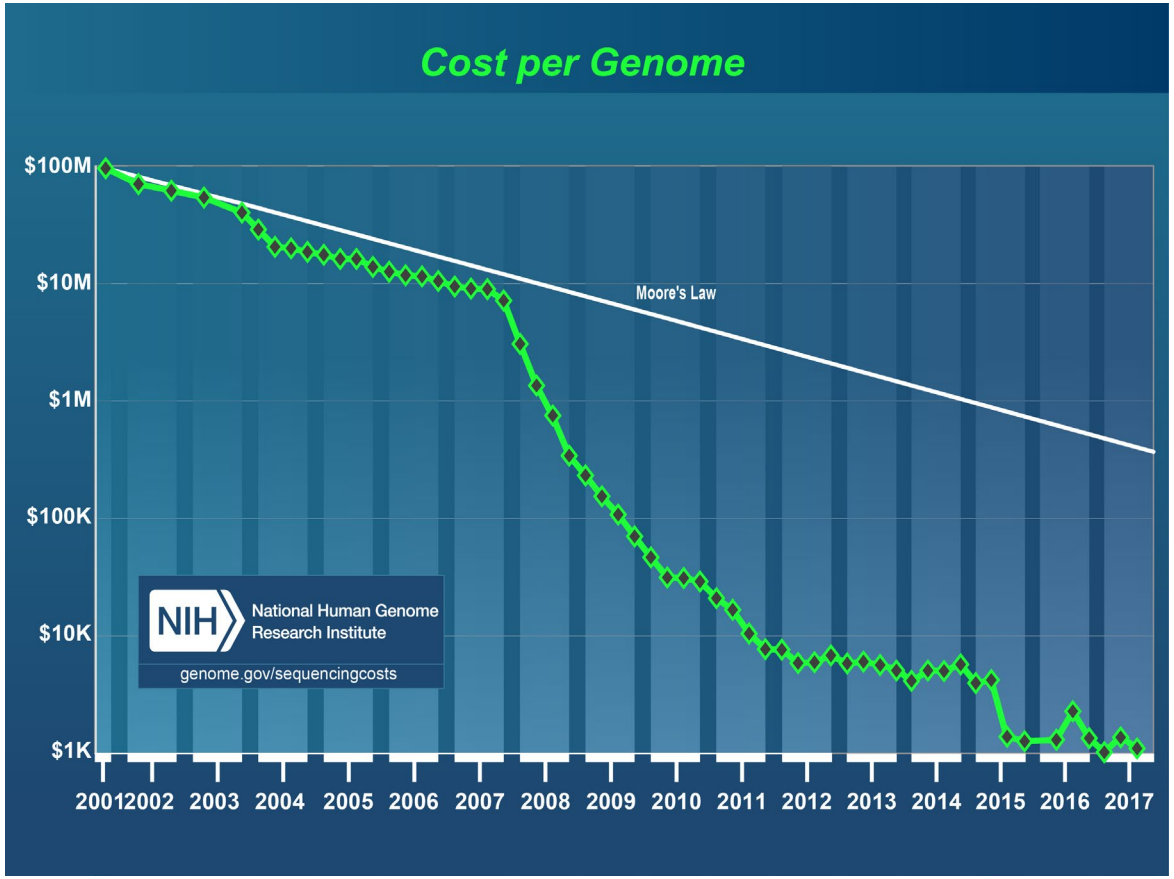


2003 - Human Genome Project is completed



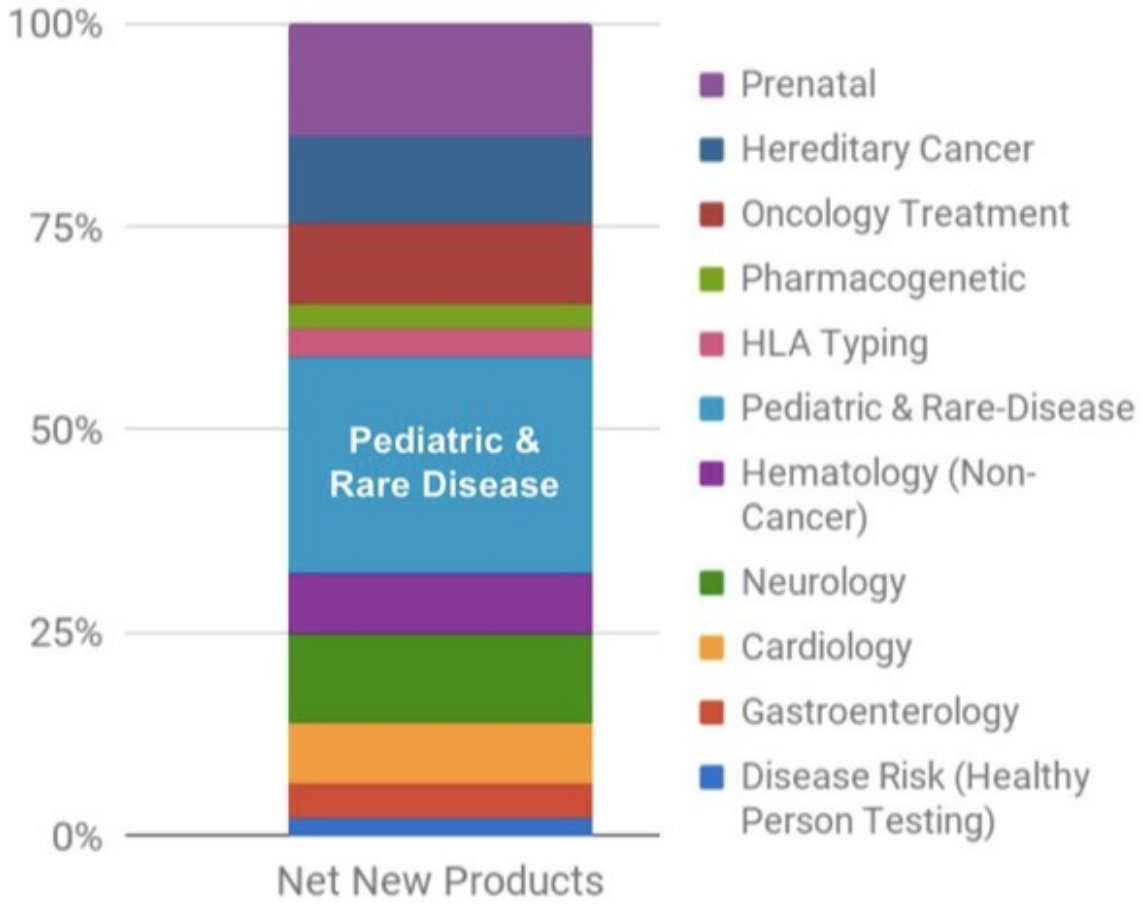
2008 Next Generation Sequencing Invented

Cost of Genetic Testing



Due to NGS and Supreme Court DNA patent ruling, cost for DNA testing is dramatically reduced, making it affordable for everyone.

75,000+ Medical Tests on the Market



Plus Direct To Consumer Testing

23andMe®

ancestryDNA

XCODE LIFE

Direct to Consumer Tests Unhelpful?

- Results are not diagnostic
- May raise more concerns
- Usually does not provide Genetic Counseling, resulting in confusion
- May misguide individuals making health choices
- FDA has only authorized certain tests
  - Example: 23andMe only tests 3 alleles for breast cancer, out of thousands

*NIH Website, Health Psychology, JAMA

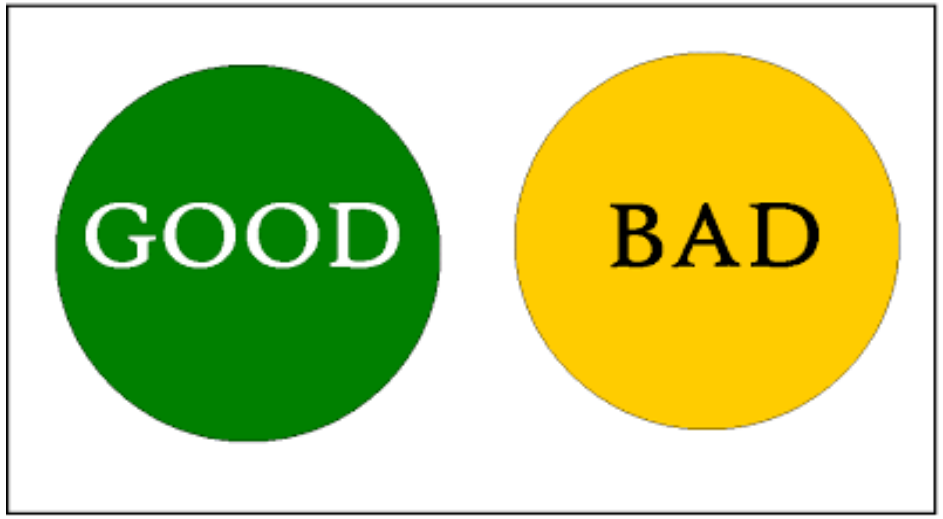
My Testing Approach

- I use Labs that have been researched by me and meet high standards learned in my Precision Medicine training, and have full accreditations
- Genetic Counseling and Medical History review is included with all tests – it starts with me
- I will coordinate results with your specialists
- Reports are clear and actionable

Warning

Genetic Information Nondiscrimination Act protects against discrimination in health insurance and employment

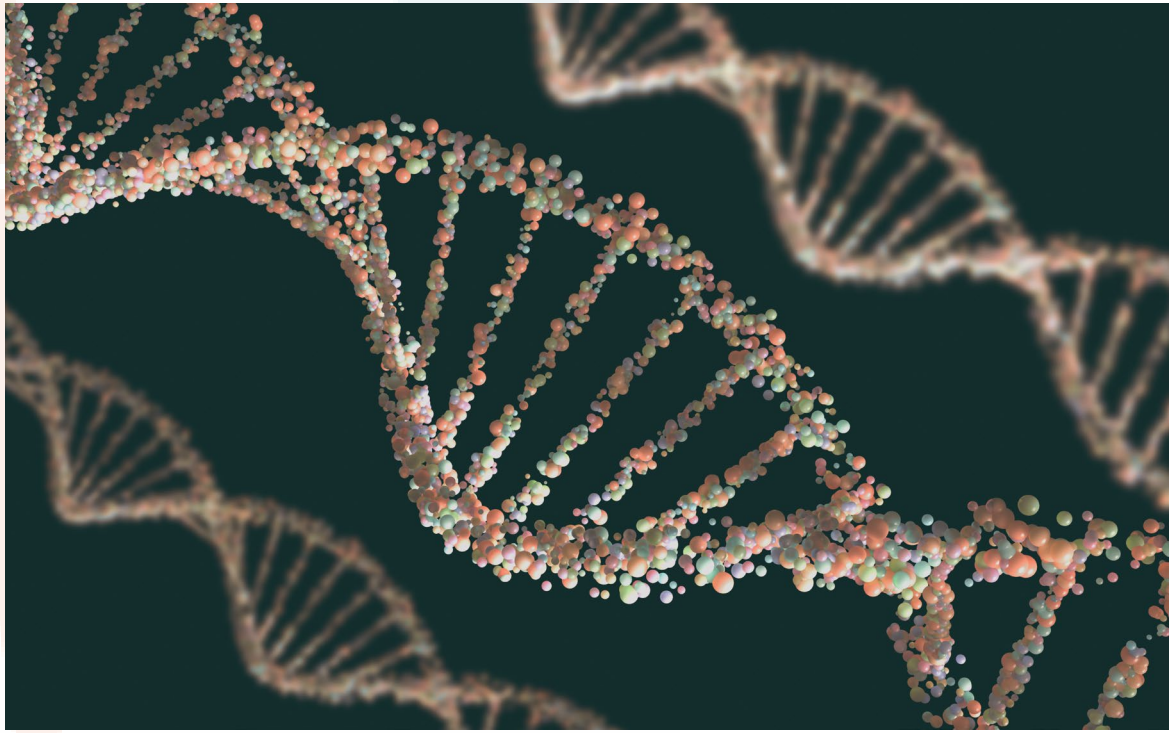
However, there are currently no exclusions for long term health care and life insurance.



Our Precision Medicine Program

Our Precision Medicine Program

1. Family History
2. Drug Response
3. Comprehensive



Family History

- 1^0 relatives (parents, children, and full siblings)
- 2^0 relatives (grandparents, aunts/uncles, nieces/nephews, grandchildren, and half-siblings)
- Type of primary disease
- Age at diagnosis
- Jewish ancestry
- Lineage (maternal or paternal)

Useful Tool

My Family Health Portrait

A tool from the Surgeon General

Language English

Using My Family Health Portrait you can:

- Enter your family health history.
- Learn about your risk for conditions that can run in families.
- Print your family health history to share with family or your health care provider.
- Save your family health history so you can update it over time.

Talking with your health care provider about your family health history can help you stay healthy!

Learn more about My Family Health Portrait

Create a Family Health History

Use a Saved History

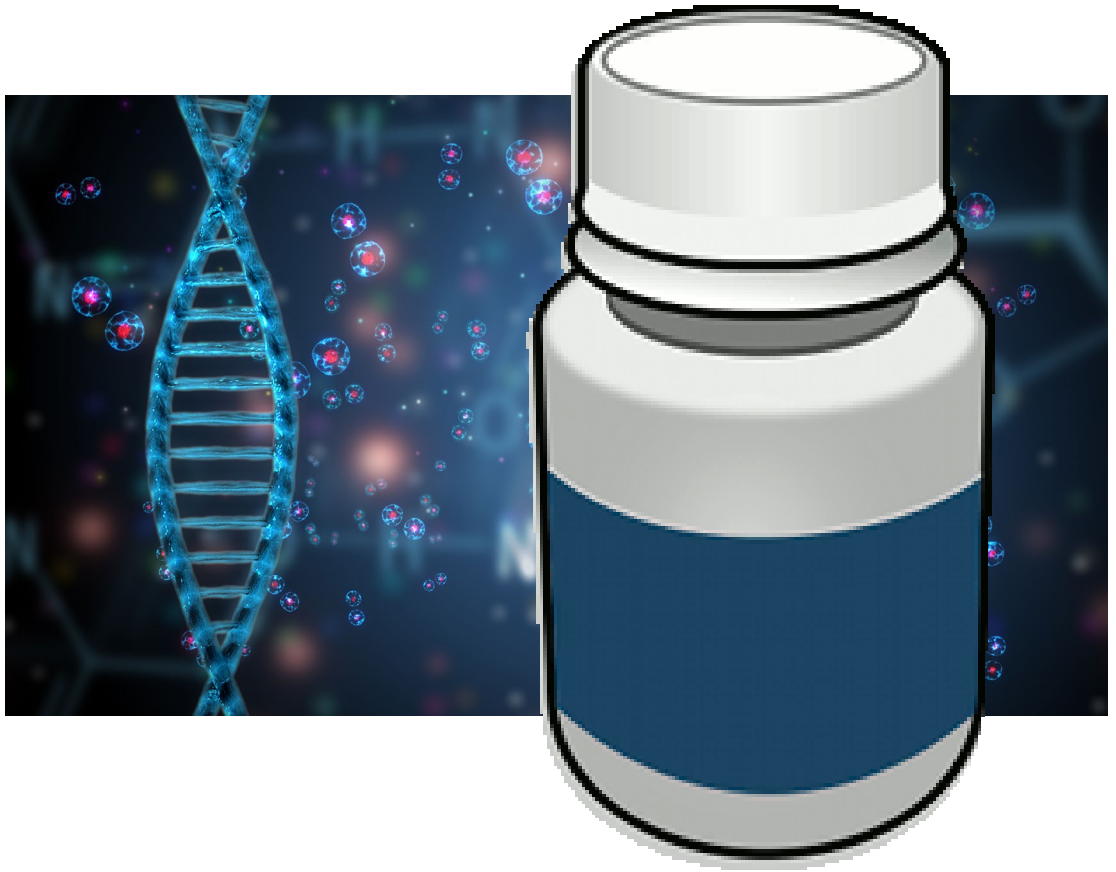
FAQS / Costs

- Family Tree can be worked on your own. Family gatherings are a good time. Send us your results and we can make it part of your chart.
- If Family History indicates certain risks, we will work with your insurance to get specialized tests.
- If you can’t get your family history, consider the Comprehensive Genetic test option.

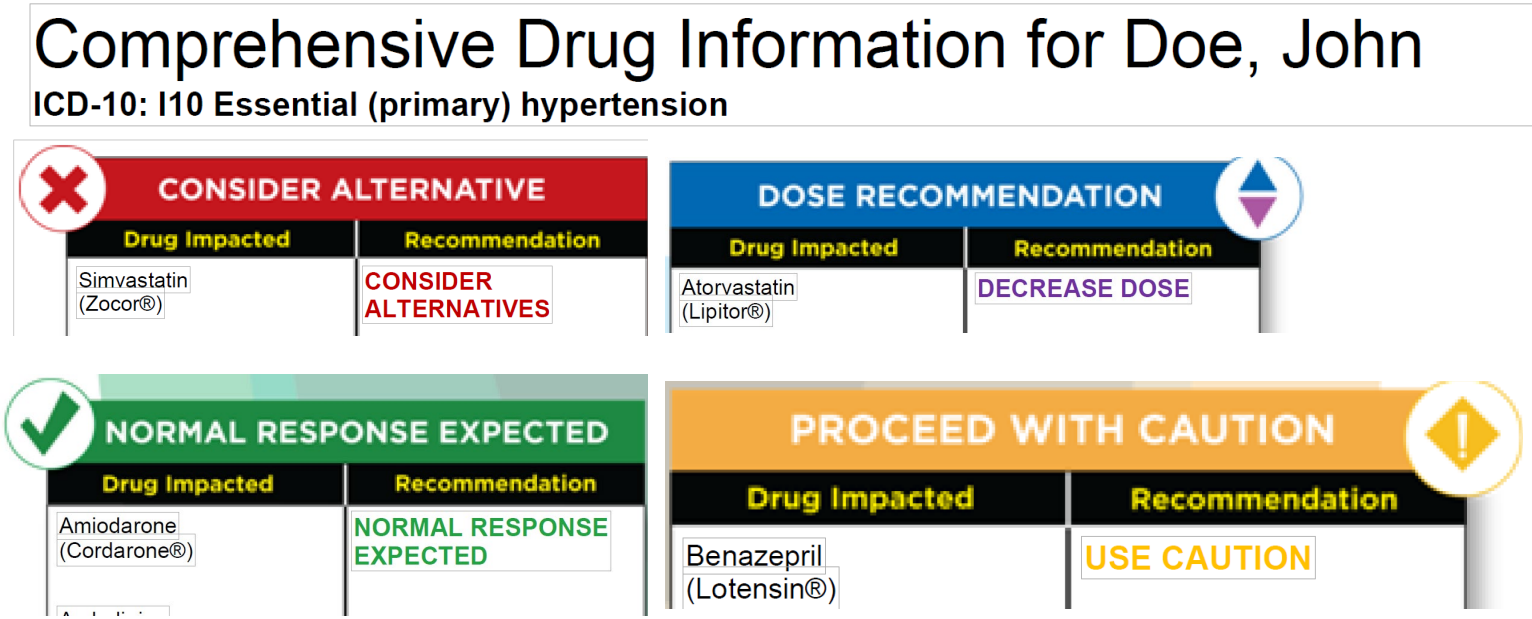
This is part of your standard Concierge service

Drug Response

- Testing to see how you respond to drug therapy
- Checks for over 300 drug responses.
- Checks over 300 Medical Conditions
- Compares current medications
- Provide clear guidance



Example Report



Comprehensive Drug Information for Doe, John

ICD-10: I10 Essential (primary) hypertension

CONSIDER ALTERNATIVE

Drug Impacted	Recommendation
Simvastatin (Zocor®)	CONSIDER ALTERNATIVES

DOSE RECOMMENDATION

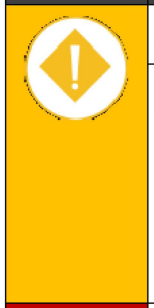
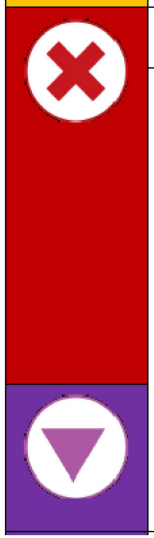
Drug Impacted	Recommendation
Atorvastatin (Lipitor®)	DECREASE DOSE

NORMAL RESPONSE EXPECTED

Drug Impacted	Recommendation
Amiodarone (Cordarone®)	NORMAL RESPONSE EXPECTED

PROCEED WITH CAUTION

Drug Impacted	Recommendation
Benazepril (Lotensin®)	USE CAUTION

Action	Drug Impacted	Evidence Level	Clinical Interpretation	Gene/Genotype	Phenotype
	**Antilipemic Agents:**				
	Fenofibrate (Tricor®)	○	**USE CAUTION** due to decreased response	**APOB** WT/WT	rs676210 GG Genotype
	**Antilipemic Agents (Statins):**				
	Simvastatin (Zocor®)	◖	**CONSIDER ALTERNATIVES** OR **DECREASE DOSE** to 20mg daily	**SLCO1B1** *5/*5	Low Activity

NA	**Antihypertensive Drugs:**				
	Valsartan	NA	**PHARMACOGENOMICS EVIDENCE NOT AVAILABLE**	NA	NA

✓	**Calcium Channel Blockers:**				
	Amlodipine (Norvasc®)	◖	**NORMAL RESPONSE EXPECTED**	**CYP3A4** *1A/*1A	Normal Metabolizer
	Diltiazem (Cardizem®)	○			
	Felodipine (Plendil®)	○			
	Lercanidipine (Zanidip®)	○			
	Nisoldipine (Sular®)	○			
✓	**Calcium Channel Blockers:**				
	Verapamil (Calan®)	◖	**NORMAL RESPONSE EXPECTED**	**NOS1AP** c.106-38510G>T/c.106-38510G>T	rs10494366 TT genotype/rs10800397 C Allele Carrier/rs10919035 C Allele Carrier

Gene	Genotype	Phenotype
ABCB1	c.3435T>C/c.2677T>G	rs2032582 AC genotype/rs1045642 AG genotype
ACE	WT/ACE Insertion	Heterozygous ACE Insertion
ADRA2A	WT/c.-1252G>C	rs1800544 GC genotype/rs1800545 GG genotype
AGTR1	WT/WT	rs5186 AA genotype
ANKK1	WT/A1	A1 Heterozygous
APOB	WT/WT	rs676210 GG Genotype
APOE	WT/WT	Non E2 Carrier
ATM	WT/c.175-5285G>T	rs11212617 AC genotype

FAQS / Costs

Useful for patients on an least one prescription medication or medical condition

Swab/Saliva Kits are available at the office, generally takes 2-4 weeks to process.

Counseling session includes review of your medical history, medications, and test results.

$175 One Time, or Free with annual membership pre-payment.

Comprehensive 3

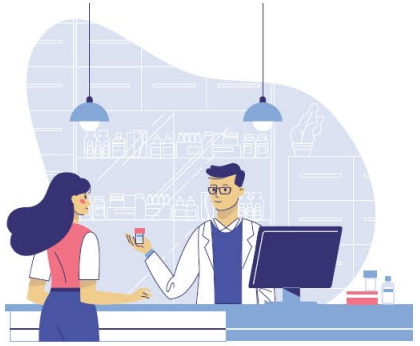
Comprehensive Predictive Test, including everything in Level 2 Drug Response Pharmacogenetics plus more.

1 Health Risks

2 Wellness

3 Ancestry

4 Drug Response



Heart Disease

Sequence 114 genes that predispose an individual to or directly cause cardiovascular disease or sudden death including:

- **Cardiomyopathies & Arrhythmias**
- **Hereditary Cholesterol Disorders**
- **Hypertension**
- **Blood Clotting / Vascular Disorders**

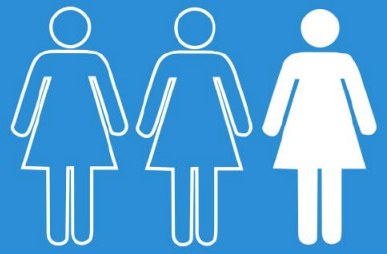
1 in every 4 deaths is due to heart disease.

1/100 individuals carries a genetic heart defect.

Cancer

Sequence 83 genes that confer risk to a variety of inherited cancers including breast, colorectal, prostate and more:

- **Breast & Ovarian Cancer**
- **Lynch Syndrome**
- **Prostate Cancer**
- **Pancreatic Cancer**



1 in 3 people get cancer during their lifetime.

10 - 15% of cancer is caused by genetics.

Infertility

Sequence 40 genes responsible for some of the leading causes of infertility in both men and women:

- **Diminished Ovarian Reserve**
- **Polycystic Ovarian Syndrome**
- **Recurrent Pregnancy Loss**
- **Low Sperm Count / Poor Quality Sperm**

1 in 6 couples suffers from infertility.

10% of infertility is caused by genetics.

Vision Loss

Sequence 16 genes that are responsible for a predisposition for early onset vision loss and conditions including:

- **Glaucoma**
- **Macular Degeneration**
- **Corneal Dystrophies**
- **Adverse Lasik Response**

1 in 20 people have a mutation that leads to vision loss.

1/1000 individuals carry a mutation that leads to blindness after lasik.

Neurodegenerative Disease

Sequence 39 genes that confer a risk of progressive neurodegenerative diseases including:

- **Parkinson's Disease**
- **Amyotrophic Lateral Sclerosis**
- **Early/late-onset Alzheimer's Disease**

By age 85, nearly 33% of individuals suffer from dementia.

1/200 individuals will experience an early onset neurological disease.

Other Genomic Health Conditions

Sequence 13 genes that may cause major health issues including but not limited to:

- **Metabolic Disorders**
- **Respiratory Disorders**
- **Toxicity from Anesthesia**
- **Vascular Disorders**

Major Disorders Included:

- Stroke
- Alpha-1 Antitrypsin
- Wilson Disease
- Primary Ciliary Dyskinesia
- Malignant Hypothermia
- Pseudocholinesterase Deficiency
- Ornithine Transcarbamylase Deficiency

Wellness - Nutrition

Sequence 30 genes that affect an individual's eating habits and ability to metabolize, or even tolerate, various foods:

- **Weight & Eating Habits**
- **Response to Diets**
- **Food Intolerances**
- **Vitamin & Nutrition Needs**

Many food intolerances are driven by genes.

Our genes may help us find our ideal eating habits and ideal diets.

Wellness – Fitness & Exercise

Sequence 18 genes that may influence response to different kinds of exercise as well as ideal recovery regimen:

- **Strength vs. Endurance Training**
- **Exercise Recovery Time**
- **Training Response**
- **Exercise Behavior**

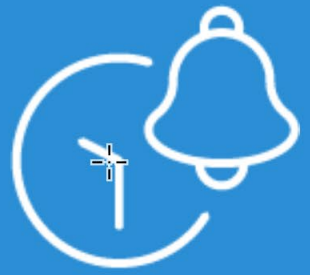
Muscle fiber type affects athletic performance.

Both performance and recovery rates have observed genetic links.

Wellness – Sleep

Sequence 12 genes that affect sleep cycle. Understand your ideal sleep duration as well as whether or not you experience sleep movement:

- **Sleep Disorders**
- **Sleep Duration**
- **Narcolepsy**
- **Sleep Movement**



Determine whether you need more or less sleep than average.

Discover issues that may affect your sleep quality.

Example Health Risk Report

Summary of Results

Clinical Area	Health Risk	Treatment Recommendations
Cardiovascular	Severe Health Risk Identified	Personalized Treatment Recommendation Identified
Oncology	No Health Risk Identified	No Treatment Recommendation Identified
Neurology	No Health Risk Identified	No Treatment Recommendation Identified
Infertility	No Health Risk Identified	No Treatment Recommendation Identified
Hereditary Eye Disorders	No Health Risk Identified	No Treatment Recommendation Identified
Metabolic Disorders	No Health Risk Identified	No Treatment Recommendation Identified

Detailed Results

Cardiovascular

Inherited cardiovascular disorders can cause increased risks for heart attack and stroke.

Disease Type	Result
Aortopathies	No variant(s) identified. Interpretation: No increased risk for this condition based on these results.
Cardiomyopathy and Arrhythmia	No variant(s) identified. Interpretation: No increased risk for this condition based on these results.
Hereditary Cholesterol and Lipid Disorders	Pathogenic Variant Identified

Variant Identified:

Gene	Variant	Inheritance	Zygosity
LDLR	c.654_656delTGG	Autosomal Dominant	Heterozygous

Interpretation: A heterozgyous pathogenic variant (c.654_656delTGG) was identified in the LDLR gene, which indicates that this patient may be affected with, or predisposed to developing, familial hypercholesterolemia. Familial hypercholesterolemia is an inherited condition which causes elevated levels of LDL-C cholesterol and an increased risk for premature cardiovascular disease.

Gene Information: LDLR

The LDLR gene encodes the low-density lipoprotein receptor which is involved in regulating the level of cholesterol circulating in the blood. Mutations in LDLR are associated with autosomal dominant familial hypercholesterolemia (OMIM ID: 143890).

FAQs / Process

Swab/Saliva Kits are available at the office, generally takes 4-6 weeks to process.

Counseling session includes review of your medical history, medications, and test results.

$575 One Time, or $400 with annual membership pre-payment.

Summary of Precision Medicine Program

Level	Who	Cost*
	Everyone – take some time to gather your detailed history, we will work together on insurance tests	No cost
	Almost Everyone: Patients with one or more medications or medical conditions.	$175 one time fee, or fee waived with Annual Concierge Prepayment*
	Patients that want to know every aspect of their genome and/or are unsure of their family history.	$575 one time fee, or $400 with Annual Concierge Prepayment*

*Discounted Until 7/31/2019


Questions?