Genomic Medicine Implementation in a High Value, Learning Healthcare Laboratory

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Geisinger Health System

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An Integrated Health Care Delivery System

Geisinger Health System
Glenn Steele, MD, PhD
President and CEO

Geisinger Clinic
- ~1,100 physician group practice
- ~700 advanced practitioners (PAs, CRNs)
- 1/3rd primary care
- 2/3rd specialists
- ~410 residents/fellow
- ~270 medical students

IP & OP Facilities
- 2 tertiary/quaternary teaching hospitals
  Geisinger Medical Center
  Geisinger Wyoming Valley
- 49 community-based outpatient clinics
- Ambulatory surgery centers
- IP substance abuse treatment center

Geisinger Health Plan
- ~450,000 member health plan
- members in 5 states
- Ranked 1st in PA for quality*
- Ranked 3rd in the US*

*US News and World Report
Regional Demographics

• 2.6 million people in 31 county service area
• Older and poorer relative to national averages
• Most counties officially designated as rural and medically underserved
• Non-transient: <1% annual out-migration rate in most counties
• 96% White European descent
Geisinger Health System

• **Mission**
  Enhance the quality of life through an integrated health service organization based on a balanced program of patient care, education, research, and community service.

• **Geisinger Brand**
  – Quality
  – Value
  – Partnerships
  – Advocacy
Overview of Strategic Plan

- Quality and Innovation
  - Patient centered focus
    - Patient activation (empowerment)
    - Culture of quality, safety and health
  - Value re-engineering
  - Transformational changes – embedding innovations

- Market Leadership
  - Collaboration/partnerships (local, regional, national)
  - Scaling and generalizing

- The Geisinger Family
  - Personal and professional well being
Transforming Healthcare with Technology

• Fully-integrated EHR (Epic’s 2nd or 3rd customer-1995)
• MyGeisinger Patient Portal, ~230,000 active users
• GeisingerConnect, 6,460 users in 812 non-GHS sites
• Active Regional Health-Information Exchange (KeyHIE)
  – 22 hospitals
  – 945,000 patients consented
• e-health (eICU®) Programs
• Clinical Decision Intelligence System (“CDIS”)
• “Open Notes”
Clinical Decision Intelligence System (CDIS) Clinical Data Warehouse

• Near real-time, system-wide data warehouse
• Searchable data format
  – EHR data (back to 2004)
    • Demographic and lifestyle data (e.g., age, height, weight, smoking)
    • Clinical measures (e.g., blood pressure)
    • Orders (prescriptions, imaging)
    • Clinical laboratory data
  – Financial data (e.g., billing, payment)
  – Operational data (e.g., events, scheduling)
  – Claims data (e.g., ambulatory, hospital, pharmacy)
• Data are cleansed, normalized and stored at most granular levels to facilitate data mining and analytics
Conduct experiments in re-engineering healthcare to improve patient outcomes and reduce cost of care

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*US News and World Report
ProvenCare® Acute Episodic Bundles

- Clinical Best Practices
- Workflow Process Redesign
- Convener for CMMI Bundling Initiative (17 organizations)
- Corporate Destination Medicine Option

CAB and PCI

Perinatal

Thoracic Lung

Heart Failure

Bariatric Surgery

Lumbar Spine

Knee Arthroscopy

COPD

Hip: Fragility Fracture or Arthroscopy
Reengineering Primary & Specialty Care

- **ProvenHealth Navigator®**
  - Advanced Medical Home covers 91 sites, serving 151,000 GHP lives and 45,000+ FFS Medicare lives
  - SNFist model expands to 17 nursing homes
  - Outcomes: reduced readmissions and improved care coordination, similar cost curve bending at GHS and University of Michigan

- **PCP & specialists coordinated patient management**
  - CKD/ESRD high risk management and psychiatric care management
  - Neurology/Dermatology/Endocrine/Cardiology/Autism

- **Convenient Care redesign of primary care/emergency medicine**
  - 12 urgent care/after hours care sites (and growing rapidly)
  - Coordinated low cost alternative to ED
Patient Activation: “Open Notes” – A Transparency and Patient Engagement Pilot

- Expanded in 2013 to 1,100+ Geisinger providers & 170,000 patients
- Launched in 2010, a 12-month trial of 105 PCPs inviting 19,000 patients to review notes through secure electronic portals (BI Deaconess, Geisinger, Harborview)
- Geisinger participation: 24 PCPs, 8,700 patients
- Results from first year:
  - Over 80% of patients opened their notes
  - Majority of patients reported feeling more in control, better prepared for visits and more likely to take medications as prescribed
  - 99% of patients and more than 80% of physicians wanted to continue
Geisinger Institute for Advanced Application

*National Laboratory For Healthcare Transformation: Leading through continual innovation*

3 Centers, 9 Labs, Informatics and Technology Trials Office, High Performance Computing Core

- Re-engineering
- Emerging technology and Informatics
- Novel data streams and big data analytics
- Rapid clinical innovation
- Remote assessment/diagnostics/treatment

- Transforming patient care
- Engaging patients
- Improving the healthcare value proposition

Organized for Synergy:
- Predictive Analytics
- Human Factors Engineering
- Diagnostics
Research Strategic Vision

- Vision: Personalized Health Care
- Emphasis on genomics
- Coupled with an innovative clinical provider system and payor
- Both of whom see “value” in potential to change course of disease/improve health outcomes/reduce costs
- Board approved 10 year Vision for Research is affirmation of a year long process by a multidisciplinary committee (inclusive of 3 board members) that translational research is part of, not separate from, Clinical Medicine.
Perspective

“Personalized medicine is the practice of clinical decision-making such that the decisions made maximize the outcomes that the patient most cares about and minimizes those that the patient fears the most, on the basis of as much knowledge about the individual’s state as is available.”

Perspective

• Clinicians practice personalized medicine (and always have)
• Currently--Intuitive medicine
  o Care for conditions that can be diagnosed only by their symptoms and only treated with therapies whose efficacy is uncertain and watching for empiric response.
  o Empiric ‘trial and error’
• Future—Precision medicine
  o the provision of care for diseases that can be precisely diagnosed, whose causes are understood, and which consequently can be treated with rules-based therapies that are predictably effective.
  o Expect genomics to play a key role in this

Adapted from The Innovator’s Prescription: A Disruptive Solution for Healthcare. Christensen, Grossman and Hwang, 2009
Five Domains of Genomics Research

1. Understanding the Structure of Genomes
2. Understanding the Biology of Genomes
3. Understanding the Biology of Disease
4. Advancing the Science of Medicine
5. Improving the Effectiveness of Healthcare

Base Pairs to Bedside
Helix to Health

Eric Green, MD, PhD
Director, NHGRI

GHS
Genomic data is different

Axiom (?)
• Germline genomic sequence data, once obtained will remain essentially unchanged over the course of the patient’s life

Consequence
• Genomic sequence data once generated must persist and be available to inform care of the patient’s life
Genomics over the Lifespan

Advantages
• Cost spread out over lifetime of care
• Avoids need to repeat testing
• Information can be used as soon as it is needed
• More precise pharmacologic therapy
  – Avoid adverse events
  – Choose best tolerated most effective therapy
• Impact on diagnostic odyssey

Questions
• Storage of information
• Information available wherever patient receives care
• Evidence of benefit (or lack thereof)
• Updating information
• Presentation of information when needed at point of care
• Discrimination
Examples Today and Tomorrow
Antiretroviral therapy

Abacavir

- Severe hypersensitivity (HSR) in 6%
  - More common Caucasian or Hispanic
- Associated with HLA-B*57:01 status
- Stratification by genotype
  - 0-0.5% HSR in HLA-B*57:01 negative
  - >70% HSR in HLA-B*57:01 positive
  - Cost-effective
- How to implement?
CDS Computerized Order Entry for Abacavir

Information needed
- Ethnicity
- Drug allergies
- Gender
- Pregnant (if female)
- Interacting medications
- CD4 count

**HLA-B*57:01 genotype**

**Information complete?**
- Yes
- No

**Adverse Reaction algorithm**

**Alert!!**
Patient is at high risk for hypersensitivity reaction. Recommend alternative treatment.

*Click here for recommended alternatives*

*more...*
CDS Computerized Order Entry for Tegretol

Information needed
- Treatment indication
- Asian Ethnicity
- Drug allergies
- Gender
- Pregnant (if female)
- Interacting medications
- CD4 count

**HLA-B*15:02 genotype**

+Asian

**Information complete?**

Yes → **Adverse Reaction algorithm**

No → Provider prompted to obtain needed information

**ALERT!!**

Patient is at high risk for Stevens-Johnson syndrome.
Recommend alternative treatment.

*Click here for recommended alternatives*

*more...*
2 yo girl hospitalized with new onset seizures and some loss of developmental milestones.

The future

EHR recognizes seizures and developmental regression as a clinical context to trigger genome sequence analysis.

Whole Genome Sequence available?

Yes

Analyze WGS

No

Generate WGS

Clinician Alert
Patient has cerebral folate transporter deficiency. Treat with oral folinic acid.

Known mutation in FOLR1 gene
Infant DNA Tests Speed Diagnosis of Rare Diseases

By GINA KOLATA
Published: October 3, 2012 | 81 Comments

From the day she was born, the girl had seizure after seizure. Doctors at Children’s Mercy Hospital in Kansas City, Mo., frantically tried to keep her alive. Weeks passed and every medication failed. Finally, her family decided to let their baby go, and the medical devices were withdrawn. She was 5 weeks old.

Her doctors suspected a genetic disorder, and as it happened the hospital had just begun a study of a new technique for quickly analyzing the DNA of newborns, zeroing in on mutations that can cause disease.

This new method, published on Wednesday in the magazine Science Translational Medicine, is a proof of concept — a totally unexpected treatment.
Geisinger Genomics for Health Initiative
Implementation of clinically useful genomic data to improve health and well-being for individuals, families and communities

MyCode Community
- Large, stable population
- >95% participation
- Ethically valid consent
- Permission to recontact
- e-recruitment, consenting (MyGeisinger)

Clinically Relevant Genomic Data
- Return to patients, physicians, EMR by expert team (genetic counseling, clinical genetics, bioethics)
- Clinical research, health outcomes and economic analyses
- Dissemination of new genomics-informed care delivery models

Funded collaborations
- eMERGE Network (NIH)
- ClinGen Resource (NIH)
- PCORI

GHS-Regeneron Collaboration
- >100,000 pts consented
- >25,000 WES first 5 years
Geisinger MyCode® Project

MyCode Project
CONTRIBUTE TO THE FUTURE OF HEALTHCARE

Geisinger Center For Health Research
100 North Academy Avenue
Danville, PA 17822

WWW.GEISINGER.ORG

We would like you to take part in MyCode, a project that will involve collection and storage of blood samples and health information from 200,000 patients. Researchers will use your blood to study your genes. This information will help researchers to understand how diseases develop and how we can improve detection and treatment of diseases.

WHAT WILL YOU BE ASKED TO DO?
1) Complete the MyCode consent form.
2) Give us permission to collect up to two tablespoons of your blood. We will only collect the MyCode blood sample when you are already having blood drawn that your doctor ordered.
3) Choose whether your blood can be collected one time only, or whether your blood will be collected up to one time per year for as long as you allow it.
4) Allow us to get information from your electronic health record (EHR) about your health history.

WHAT WILL WE DO WITH THE INFORMATION?
If blood samples and medical information are already available, researchers can study and understand what causes diseases including ways to detect diseases earlier and to improve treatments.

WHY WERE YOU ASKED TO TAKE PART?
We are asking anyone who is 18 years of age or older and is a Geisinger Clinic patient to take part.

WHAT ARE THE BENEFITS/RISKS INVOLVED?
There are few benefits or risks to you. You will not receive money for your help. It will not cost you money to take part. This research will not affect your health. The research may lead to discoveries that help doctors learn about diseases in general. We will take special care to protect your privacy.

WHAT IF YOU DON'T WANT TO BE INVOLVED?
Participation is completely voluntary. Your choice to take part or not take part in the project will not affect your health care.

FOR MORE INFORMATION
You can call us at 1.888.910.6486 to ask for more information about MyCode.

1.888.910.6486

to ask for more information about MyCode.
Leveraging the EMR and Clinical Infrastructure For Large-Scale iobanking

Clinic schedule and patient eligibility from EMR

Patient informed consent

Blood draw order placed in EMR

Research samples retrieved and coded

Centrally collected via Geisinger lab courier service

Blood sample collected via clinical phlebotomy

CLIA

Long-term storage and tracking

Sample analysis
<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual patients</td>
<td>&gt;45,000</td>
</tr>
<tr>
<td>Primary care</td>
<td>&gt;23,130</td>
</tr>
<tr>
<td>Specialty clinic</td>
<td>&gt;15,200*</td>
</tr>
<tr>
<td>Blood samples</td>
<td>28,637</td>
</tr>
<tr>
<td>Serum samples</td>
<td>51,716</td>
</tr>
<tr>
<td>DNA samples</td>
<td>21,314</td>
</tr>
<tr>
<td>Tissue samples</td>
<td>6,059</td>
</tr>
<tr>
<td>Total samples</td>
<td>&gt;112,000</td>
</tr>
</tbody>
</table>

* >70% from Adult Obesity, Cardiac Cath and Vasc. Surgery
### Common Conditions in the MyCode® Primary Care Cohort (16,714 total patients)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteoarthritis</td>
<td>4,323</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>402</td>
</tr>
<tr>
<td>Prostate Cancer</td>
<td>410</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>1,463</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>9,454</td>
</tr>
<tr>
<td>Ischemic stroke</td>
<td>1,217</td>
</tr>
<tr>
<td>BMI &gt;40</td>
<td>1,814</td>
</tr>
<tr>
<td>Type 2 diabetes</td>
<td>3,853</td>
</tr>
<tr>
<td>Asthma</td>
<td>1,999</td>
</tr>
<tr>
<td>Chronic kidney disease</td>
<td>1,726</td>
</tr>
</tbody>
</table>

*2 or more office visits with diagnosis code or problem list entry; data as of 1-1-2011
Research Data Broker and Clinical Decision Intelligence System (CDIS) Data Warehouse

- EHR
  - Orders
  - Diagnoses
  - Lab values
  - Meds
  - Procedures
  - Etc.

- CDIS
  - searchable
  - exportable

- Data Broker
  - Research data
  - linkable

- Investigator

- TPO
  - PHI Firewall

- Central Biobank (MyC)
  - >45,000 consented participants
  - >100,000 samples
  - Blood, serum, DNA, tissue

- Governing Board

- GEISINGER HEALTH SYSTEM
Prescription Drug Orders in the EMRs of MyCode Participants
(21,404 patients)
BMI Distribution – MyCode® Primary Care Cohort

MyCode Females

Mean: 32.0
Median: 30.5
sd: 10.6

MyCode Males

Mean: 30.0
Median: 30.0
sd: 7.1
Gastric Bypass Surgery Outcomes

Weight Loss After Gastric Bypass Surgery

[Diagram showing weight loss over time after gastric bypass surgery]
Melanocortin 4 Receptor (MC4R)

- Regulates neural signaling that controls feeding behavior
- Null mutations in mice produce obesity and insulin resistance
- MC4R mutations are most common known form of monogenic obesity
- Sequenced MC4R gene in 1,433 Geisinger patients who underwent gastric bypass and 451 lean Geisinger patients (MyCode)
Effect of $MC4R/125L$ Variant on Weight Loss in Gastric Bypass Patients

Normoglycemic  
- Reference allele
- $125L$ allele

Diabetic  
- Reference allele
- $125L$ allele
Effect of \textit{MC4R(I125L)} Allele

\textit{I125L} carriers:

- Lost 9% more weight (9kg)
- Continued rapid weight loss longer
- Regained less weight
- Were more insulin sensitive pre-surgery
PA-CURE Grant – Translational Genomics

“Utility of Genomic Data to Guide Population Screening for Abdominal Aortic Aneurysms”

1. Create a novel AAA risk scoring tool that combines genetic variant and epidemiological data, using genotype and EMR-generated data from 1,000 AAA cases and 3,000 controls.

2. Prospectively validate the genomically-informed risk model in an outpatient population.

3. Develop and evaluate a clinical implementation plan for utilization of genomic data in Geisinger outpatient clinics.
“national consortium to develop, disseminate, and apply approaches to research that combine DNA biorepositories with electronic medical record systems for large-scale, high-throughput genetic research . . . . [use] EMR systems to investigate gene-disease relationships”.

Jointly funded by the National Human Genome Research Institute and the National Institute of General Medical Sciences of the NIH

eMERGE – Phase 2: began July 1, 2011; increased emphasis on integrating genomic data into clinical practice
The eMERGE Network

Electronic Medical Records & Genomics

A consortium of biorepositories linked to electronic medical records data for conducting genomic studies
Geisinger eMERGE Aims

1. Use existing biospecimens and EMR-generated phenotypes to identify new genetic variants or validate suspected variants associated with increased disease risk or treatment response for disorders with significant public health impact. (*Discovery*)

2. Develop and test approaches to incorporate genomic data into clinical care. (*Clinical Integration*)

3. Identify sociocultural concerns of patients residing in rural areas regarding genomic medicine research. Explore ethical, legal and social issues, including return of genetic findings to patients. (*ELSI*)
eMERGE PGx-PGRN

- VIP (“Very Important Pharmacogene”) sequence capture platform developed (Nimblegen)
- 84 PGx genes (metabolism, transport, drug targets)
- Exons plus flanking sequence (~940 kb)

- Pre-emptive targeted sequencing of DNA samples from 1,000 Geisinger patients with increased likelihood of receiving PGx drug within 2 years
- EHR integration/decision support tools to be developed
- Initial drug-gene pairs to be returned: statins, Plavix, warfarin
Genetics, Genomics & Genomic Medicine

Senior Investigators (6)
David J. Carey, Ph.D.
David H. Ledbetter, Ph.D.
Christa Lese Martin, Ph.D.
Anne Moon, M.D.
Michael Murray, M.D.
Marc Williams, M.D.

Investigators (cont’d)
Janet Williams, M.S.
Helena Kuiviniemi, M.D., Ph.D.
Gerard Tromp, Ph.D.
Andres Moreno De Luca, M.D.
Tooraj Mirshahi, Ph.D.
Alanna Rahm, Ph.D.
Monica Giovanni, M.S.

Investigators (10)
Andrew Faucett, MS
Brenda Finucane, MS
Shibani Kanunga, MD
The Clinical Genome Resource (ClinGen)

Collaboration between:

**NHGRI U41 Grant**
Pls: Rehm (Harvard), Martin (Geisinger), Nussbaum (UCSF), Ledbetter (Geisinger)

**NHGRI U01 “Clinically Relevant Variant Resource” Grants**
Grant 1 Pls: Plon (Baylor), Bustamante (Stanford)
Grant 2 Pls: Berg (UNC), Watson (ACMG), Ledbetter/Williams (Geisinger)

**NCBI**
ClinVar
The Clinical Genome Resource (ClinGen)

- **Purpose:** Create a centralized repository and interconnected resources of clinically annotated genes and variants to improve our understanding of genomic variation and optimize its use in genomic medicine.

- **Main activities:**
  - Facilitate deposition of variants and phenotypes into ClinVar & develop methods for defining pathogenicity (Harvard/Geisinger/UCSF)
  - Organize clinical curation groups, lead consensus efforts for clinical actionability, & ensure interoperability with electronic health records (UNC/ACMG/Geisinger)
  - Build informatics support, facilitate data access by the community, and develop novel machine learning algorithms (Baylor/Stanford)
Why Change MyCode™

• National discussion about the duty to return research results
  • Engage research participants
  • Geisinger is a health system – patient benefit a priority

• Cost of Whole Genome Sequencing (WGS) and Whole Exome Sequencing (WES) dropping rapidly
  • Results might actually be available for many participants

• Set the national biobank standard and become attractive to research partners
  • Bring benefits of WGS and WES to Geisinger Family
Focus Groups

- 6 focus groups held
- Bariatric surgery group and Primary Care Clinics in Bloomsburg and Kulpmont
- 93 participants – 57% F, 43% M
  - 42% Age 61 – 70
  - 23% Age 51 – 60
  - 22% Age 71 & >
  - 8% Age 41 – 50
  - 5% Age 18 – 40
  - (Ages match biobank participants)
- 49.5% GHS patients for 20+ years
- 85% receive majority of care at GHS
Focus Group Discussion

- Pharmacogenomics (genetic variation that impacts medication dosage and choice)
- Recessive Carrier (risk for serious disease, information for children and grandchildren)
- Increased Risk for Preventable or Treatable condition
- Increased Risk for NON Preventable or Treatable condition
- Genetic changes that we currently do not understand
Results of Focus Groups

• Wanted **ALL** results
• Results should be returned to healthcare provider and participant (most preferred same time)
• Geisinger should develop educational materials and expert support system
• Results should be put in EPIC
MyCode™ Consent & Protocol Changes

- Research may include whole exome or whole genome sequencing
- Geisinger intends to return results that are medically actionable after CLIA confirmation
- Geisinger will NOT return results that are NOT medically actionable
- Geisinger experts will decide what to return
- Expansion of research collaborators
- Sharing research data with national databases to improve ability to interpret results
- Commitment to regular communication to participants
- IRB approval Oct 14, 2013
Geisinger Genomic Sequencing Research Study

Objective: Improve our ability to predict and prevent disease, optimize treatments based on genetic information for each individual

- Partnership between Geisinger Health System and Regeneron
- 5 – 10 Year Genomic Sequencing Study
- 100,000 Study Participants
Collaborators with complementary expertise

**Geisinger Resources**
- Unique community partnership, trust
- Stable population (three generation families)
- 45,000+ MyCode participants now; goal of 100,000+
- Strong research expertise in improving healthcare

**Regeneron Resources**
- Strong scientific team
- State-of-the-art DNA sequencing facility
- Strong financial resources
- Focus on new drug development
Genomic Sequencing Study Goal

- Identify disease risks and prevention based on individual’s genetic information
- Improved treatment of disease by optimizing for individual patients based on genetic information
- Identify right drug, right dose for each patient
- Identify new treatments, new drugs

Improve the health of Geisinger patients and patients around the world for generations to come.
Vigorous Privacy Protection

- Geisinger is an expert on privacy protection and will use similar system for this project
- Samples and records assigned coded ID numbers before sharing with researchers
- Only Geisinger employees have access to ID codes
- All researchers agree not to attempt to re-identify participants
- Regeneron agreed to follow Geisinger’s vigorous privacy standards
Benefits of Participation

- Long-term goal to improve health and well-being for generations to come based on individual genetic information
  - our patients want to contribute to improved knowledge and health for others
- Participants with clinically actionable findings resulting from their gene sequencing will learn beneficial information
Collaboration Goal: A Translational Genomics Pipeline

- GHS Clinical Data
- Validated Phenotypes
- Gene-Phenotype Associations
- Drug discovery (REGN)
- Gene-Phenotype Associations
- Research and clinical use (GHS)
- Geisinger Patients
- Biobank
- Genomic Data
Collaboration Operational Elements

1. Expand MyCode biobank
   • REGN funds the addition of 100,000 new patients and their samples (blood, serum, DNA) over 5 years

2. Clinical data mining and modeling
   • REGN funds a team of GHS data analysts and programmers to create a research database using GHS clinical data and to develop and validate “phenotyping algorithms”

3. Genomic analysis
   • REGN performs next generation DNA sequence analysis (minimum 25K whole exome sequences)
   • Other genomic analyses, e.g. high density genotype analysis?
Clinical Engagement

Research Opportunities
• Consultative Engagement of Clinical Experts
  o Defining the Relevant Phenotype (Phenotype first)
  o Extending the Phenotyping (Genotype first)

Return of Results
• Patients with genomic findings that warrant return for clinical management will receive that result (initially 2-5%).
• Infrastructure and decision support to be developed
GHS Research Opportunities

Unique Resources
- Expanded biobank
- Genomic data
- Clinical database
- Phenotype algorithms

Research Opportunities
- Genomic discovery
- Predictive risk modeling
- Clinical implementation
- Patient and provider education
- Ethical, legal social implications
- Health services research
- Health economics
An Ethical Framework of Three Principles

- **Principle of Trust**: Geisinger will educate and inform MyCode™ participants, engage them in dialogue and seek their perspectives on research.

- **Principle of Respect**: Geisinger will utilize ethically sound practices in seeking the consent of prospective participants in MyCode™.

- **Principle of Care**: Geisinger will care for MyCode™ participants by returning clinically actionable genomic results to them and to the health professionals who care for them.

- **Consent to & Participation in MyCode™ + Return of Results**: Geisinger will educate and inform MyCode™ participants, engage them in dialogue and seek their perspectives on research.
Do any of the lessons learned at Geisinger generalize to other healthcare systems?
xG Health Solutions™: Facts and Figures

Originated from Geisinger Health Systems’ (GHS) interest in exporting its health care performance improvement innovations and strategies.

Built on early experience of Geisinger Consulting Group and out-of-state efforts of Geisinger Health Plan.

Spun out of Geisinger as independent, for-profit company in 02/2013 with $40M from Oak Investment Partners and multiple contributions from GHS.

Mission is to help health care providers be successful under risk- and performance-based payment arrangements.

Target Customers: Multi-hospital systems, Medicare & Commercial ACOs, MA plans, and large MD groups taking, or planning to take, financial risk.

23 current clients; ~100 employees.
High value, integrated healthcare system provides ideal “learning healthcare laboratory” to perform experiments to improve patient outcomes and reduce total cost of care.

Genomics data, available from birth (or prenatally) may allow personalized health guidance in the form of prevention and optimized treatment through the lifespan.

Lessons learned from a unique model system will be tested in other demographic areas and healthcare systems.