Changing Landscape of Inherited Cancer: Use of Electronic Medical Record to Improve Patient Care

Georgia L. Wiesner, MD
Professor of Medicine,
Vanderbilt University Medical Center

Genomic and Precision Medicine Forum
Duke University
9-12-2019
Overview

• Evolution of clinical cancer genetics in the background of personalized medicine

• Clinical “disruption” from advances in technology
  • Panels
  • Incidental findings
  • Tumor sequencing

• Difficulty in recognizing patients at risk for cancer

• Solutions
Genes and Health

Promise of genomic medicine
Impact on patients and families
Personalized Medicine

• “a medical model that proposes the customization of healthcare, with decisions and practices being tailored to the individual patient by use of genetic or other information.”

• Tailored therapy based on a person’s own genetics
Personalized Medicine

• Genomic Medicine
• Precision Medicine
• Predictive
• Preventative
• Personal(ized)
• Participatory
Cancer Genetic Challenge

Germline mutations or variation
+ Environmental Factors = G+E

Familial cancer

Inherited cancer
Germline mutations

Sporadic cancer
Environmental factors
## Family History Risks

<table>
<thead>
<tr>
<th>Cancer site</th>
<th>Parental proband</th>
<th>Sibling proband</th>
<th>Both are probands</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O</td>
<td>SIR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Upper aerodigestive tract</td>
<td>39</td>
<td>1.72</td>
<td>1.22 to 2.35</td>
</tr>
<tr>
<td>Oesophagus</td>
<td>8</td>
<td>3.14</td>
<td>1.34 to 6.22</td>
</tr>
<tr>
<td>Stomach</td>
<td>82</td>
<td>2.17</td>
<td>1.73 to 2.69</td>
</tr>
<tr>
<td>Colorectum*</td>
<td>681</td>
<td>1.86</td>
<td>1.73 to 2.01</td>
</tr>
<tr>
<td>Liver</td>
<td>37</td>
<td>1.66</td>
<td>1.17 to 2.28</td>
</tr>
<tr>
<td>Pancreas</td>
<td>46</td>
<td>1.87</td>
<td>1.37 to 2.49</td>
</tr>
<tr>
<td>Lung</td>
<td>365</td>
<td>2.09</td>
<td>1.88 to 2.32</td>
</tr>
<tr>
<td>Breast</td>
<td>1779</td>
<td>1.84</td>
<td>1.76 to 1.93</td>
</tr>
<tr>
<td>Cervix</td>
<td>39</td>
<td>1.82</td>
<td>1.29 to 2.49</td>
</tr>
<tr>
<td>Endometrium</td>
<td>83</td>
<td>2.48</td>
<td>1.97 to 3.07</td>
</tr>
<tr>
<td>Ovary</td>
<td>97</td>
<td>3.15</td>
<td>2.56 to 3.85</td>
</tr>
<tr>
<td>Prostate</td>
<td>922</td>
<td>2.45</td>
<td>2.30 to 2.62</td>
</tr>
<tr>
<td>Testis</td>
<td>10</td>
<td>4.26</td>
<td>2.03 to 7.87</td>
</tr>
<tr>
<td>Kidney</td>
<td>64</td>
<td>1.87</td>
<td>1.44 to 2.38</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>117</td>
<td>1.75</td>
<td>1.45 to 2.10</td>
</tr>
<tr>
<td>Melanoma</td>
<td>166</td>
<td>2.62</td>
<td>2.23 to 3.05</td>
</tr>
<tr>
<td>Skin, squamous cell</td>
<td>77</td>
<td>2.52</td>
<td>1.99 to 3.15</td>
</tr>
<tr>
<td>Nervous system</td>
<td>112</td>
<td>1.71</td>
<td>1.41 to 2.06</td>
</tr>
<tr>
<td>Thyroid gland, medullary</td>
<td>12</td>
<td>3.26</td>
<td>1.67 to 5.71</td>
</tr>
<tr>
<td>Endocrine glands</td>
<td>38</td>
<td>2.21</td>
<td>1.57 to 3.04</td>
</tr>
<tr>
<td>Non-Hodgkin’s lymphoma</td>
<td>74</td>
<td>1.82</td>
<td>1.43 to 2.28</td>
</tr>
<tr>
<td>Hodgkin’s disease</td>
<td>8</td>
<td>4.88</td>
<td>2.08 to 9.66</td>
</tr>
<tr>
<td>Myeloma</td>
<td>23</td>
<td>3.33</td>
<td>2.11 to 5.00</td>
</tr>
<tr>
<td>Leukaemia</td>
<td>55</td>
<td>1.85</td>
<td>1.39 to 2.41</td>
</tr>
</tbody>
</table>

Table 1: SIR for cancer in offspring when parents or siblings are probands

*R: observed number of cases; SIR: standardised incidence ratio.

Bold type: 95% confidence interval (CI) does not include 1.00. *Adenocarcinoma only.
Familial Risk for CRC

- Risk can vary with the number of relatives and their age at diagnosis
- Risk is usually given as a percent over a person’s lifetime

CRC general population risk is about 5% by age 79
Risk increases with age

Cases/10,000

40 y 45 yr 50 yr 60 yr 70 yr

Fam Hx neg
Fam Hx pos
Familial Cancer Risk

Risk varies by number of affected relatives and age at diagnosis

Cancer syndromes increase the risk from 10 to 50 times the population risk!!

If Mutation identified ...

Apply to Patient
- Develop cancer risk profile
- Develop risk reducing strategies

Apply to Family
- Test blood relatives
- Start prevention early
Increasing Complexity

Traditional Genetics

- Germline DNA
- Initiation of cancer
- Rare syndromes
- Ramification for Family
- Biomedical Ethics

How to identify the patients for cancer genetic assessment?

Oncology

- Tumor DNA
- Progression of cancer
- Cell biology
- Treatment of individual illness

Hereditary Cancers
Who should be tested?

CRITERIA FOR FURTHER GENETIC RISK EVALUATION

- An individual at any age with a known pathogenic/likely pathogenic variant in a cancer susceptibility gene within the family, including such variants found on research testing.
- An individual at any age with a known pathogenic/likely pathogenic variant in a cancer susceptibility gene found on tumor testing.
- An individual diagnosed at any age with any of the following:
  - Ovarian cancer
  - Pancreatic cancer
  - Metastatic prostate cancer
  - Breast cancer or high-grade (Gleason score ≥7) prostate cancer and of Ashkenazi Jewish ancestry
- An individual with a breast cancer diagnosis meeting any of the following:
  - Breast cancer diagnosed age ≤50 y
  - Triple-negative (ER-, PR-, HER2-) breast cancer diagnosed age ≤60 y
  - Two breast cancer primaries
  - Breast cancer at any age, and
    ◦ ≥1 close blood relative with:
      - breast cancer age ≤50 y; or
      - invasive ovarian cancer; or
      - male breast cancer; or
      - pancreatic cancer; or
      - high-grade (Gleason score ≥7) or metastatic prostate cancer
    ◦ ≥2 close blood relatives with breast cancer at any age

- An individual who does not meet the above criteria but has a first- or second-degree relative with any of the following:
  - Breast cancer ≤45 y
  - Ovarian cancer
  - Male breast cancer
  - Pancreatic cancer
  - Metastatic prostate cancer
  - ≥2 breast cancer primaries in a single individual
  - ≥2 individuals with breast cancer primaries on the same side of family with at least one diagnosed ≤50 y

- An individual with a personal and/or family history on the same side of the family of three or more of the following (especially if diagnosed age ≤50 y; can include multiple primary cancers in same individual):
  - breast cancer, sarcoma, adrenocortical carcinoma, brain tumor, leukemia (see LIFR-1),
  - colon cancer, endometrial cancer, thyroid cancer, kidney cancer, dermatologic manifestations, macrocephaly, or hamartomatous polyps of gastrointestinal (GI) tract (see COWD-1),
  - lobular breast cancer, diffuse gastric cancer (see CDH1 guidelines, GENE-2),
  - breast cancer, gastrointestinal cancer or hamartomatous polyps, ovarian sex chord tumors, pancreatic cancer, testicular Sertoli cell tumors, or childhood skin pigmentation (see STK11 guidelines, GENE-4)

The criteria for further risk evaluation and genetic testing are not identical. For the purposes

NCCN Breast Ovarian accessed 3-21-2019
New Guidelines: NCCN and others

Cancer Patients in whom testing may guide treatment

- Genetic Testing for inherited cancer
  - Breast Cancer
  - Ovarian Cancer
  - Prostate Cancer
  - Pancreatic Cancer
  - Colorectal Cancer
  - Endometrial Cancer
  - Tumor Sequencing
  - Heme Malignancies
  - Prostate Cancer
  - Pancreatic Cancer
  - Heme Malignancies
  - Colorectal Cancer
  - Endometrial Cancer
  - Tumor Sequencing
Identify cancer patients who meet guidelines for genetic testing, in whom treatment may be guided based on results.

<table>
<thead>
<tr>
<th>Ovarian Cancer</th>
<th>Breast cancer: ≤45</th>
<th>Metastatic Prostate Cancer</th>
<th>Pancreatic Cancer</th>
<th>TBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCC visits (#, %)</td>
<td>90/273 (33%)</td>
<td>371/814 (45.6%)</td>
<td>18/877 (2%)</td>
<td>51/935 (5.5%)</td>
</tr>
<tr>
<td>Average annual volume</td>
<td>40-50/year</td>
<td>~135/year</td>
<td>150/year</td>
<td>160/year</td>
</tr>
</tbody>
</table>

Colorectal/Endometrial Cancer:
- ≤50
- IHC/MSI results

Hematologic malignancies:
- BMF
- MDS or AML (any age)
- MDS/AML ≤45

Tumor Sequencing Results/Potential germline significance

2013-2018 Cancer Patients in VICC Cancer Registry

Courtesy Tuya Pal, MD and Lucy Wang
Barriers to Identification

• Cancer is common
• Signal to noise issue
• Family cascade
• Tumor testing
• Incidental findings
• Family history
Changing Landscape

• Many professional society guidelines
  • NCCN (National Comprehensive Cancer Network
  • Committee on Cancer

• New indications for testing

• Need for improved access and efficiency

• Lack of genetic professionals to provide services
Cancer Genetic Challenge

Familial cancer: Germline mutations or variation + Environmental Factors = G+E

Inherited cancer: Germline mutations

Sporadic cancer: Environmental factors
Hereditary Cancer Risk Assessment and Management

- Proven benefit carefully selected and counseled families by targeted cancer screening
- Surveillance and prevention can improve survival in at-risk individuals
- Non-carriers can be spared anxiety and the need for increased surveillance
- Genetic technologic advances will and are changing diagnostic and treatment modalities
Use of Family Health History

- Powerful predictor for disease risk – particularly in cancer
  - Risk algorithms available for breast, colon, melanoma, prostate, etc
  - Included in NCCN guidelines for genetic testing

- Difficult to obtain in clinical practice
  - Time limited
  - Use by specialists more than primary care
  - Hard to find in the medical record (if it is there at all)
  - Not linked to genetic tests
Use of Informatics—Rationale

• Several computer platforms have been developed to capture and analyze FHH data

• FHH should be readily available in the age of genomic medicine

• FHH should be fully integrated into the EHR

• EHR integration should include clinical decision support for the provider and education for the patient

• Hypothesize that FHH integrated into EHR and clinical workflow would systematically improve quality of care
APIs IN HEALTHCARE

Users

Applications

Developers

APIs

Data and Services

Patient Apps

HCO Developers

FHIR

Systems of Record

Systems of Engagement

Clinician Apps

HIT Developers

Proprietary

Other Apps

Third-Party Developers

Other

VANDERBILT UNIVERSITY MEDICAL CENTER

https://hitconsultant.net/2017/01/13/37163/#.XXIO75NKjGI
HL7 / FHIR General Info

- **HL7**
  - **Healthcare Standards** for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services

- **FHIR**
  - **FHIR®** – Fast Healthcare Interoperability Resources – is a next generation standards framework created by HL7. FHIR combines the best features of HL7’s v2, HL7 v3 and CDA product lines while leveraging the latest web standards and applying a tight focus on implementability.
  - RESTful API
  - Development heavily driven by implementations (see [Argonaut](#))
  - Limited genomics representation in R4 (latest release) - includes a MolecularSequence resource

- **Clinical Genomics FHIR Implementation Guide**
  - Profiles of existing FHIR resources to support exchange of genomic data
  - Supports variant level data, variant level interpretations (inherited disease, somatic, PGx), report level interpretations, recommended follow-ups, report
Collection and Use of Family History

- Active area of development
- GREAT program
- MeTree
- Jackson Lab Family History Tool Features for PCPs Table ([https://docs.google.com/spreadsheets/d/1IGsNBtyfxB7GYcLZ9zHiSoZL3f8EMfE-X0_rfg2hp_8/edit#gid=826615447](https://docs.google.com/spreadsheets/d/1IGsNBtyfxB7GYcLZ9zHiSoZL3f8EMfE-X0_rfg2hp_8/edit#gid=826615447))
<table>
<thead>
<tr>
<th>Tool Name &amp; Website</th>
<th>Collection Features</th>
<th>Risk Assessment</th>
<th>Scope</th>
<th>Other</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Collection of all 1st- and 2nd-degree relatives</td>
<td>Includes risk assessment (vs. just a collection tool)</td>
<td>Stratification to 3 categories: average, increased, high</td>
<td>Includes personal as well as family history risks</td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>Patient entered collection</td>
<td>Electronic questionnaire</td>
<td>Electronic risk assessment</td>
<td>Links to provide management</td>
<td>Spanish/other language versions available</td>
</tr>
<tr>
<td></td>
<td>Paper questionnaire</td>
<td>Stratification to 2 categories: average, increased/high</td>
<td>n/a</td>
<td>Assessment of multiple cancers beyond CRC</td>
<td>EHR integration</td>
</tr>
</tbody>
</table>

Check the "must have" features for your practice:

- **Family History Questionnaire**: YES, YES, NO, YES, NO, n/a, NO, NO, n/a, YES, NO, NO, YES, NO
- **My Family Health Portrait**: YES, YES, YES, YES, PARTIAL, YES, NO, YES, NO, NO, PARTIAL, PARTIAL, YES, YES, YES
- **It Runs in My Family**: YES, YES, YES, NO, NO, n/a, NO, NO, n/a, YES, NO, NO, YES, NO
- **MyLegacy**: YES, YES, YES, NO, YES, YES, NO, NO, YES, YES, YES, YES, NO, NO, YES
- **Family Healthware**: YES, YES, YES, NO, YES, YES, YES, NO, YES, YES, YES, YES, NO, NO, YES
- **MeTree**: YES, YES, YES, NO, YES, YES, YES, NO, YES, YES, YES, YES, NO, NO, YES
- **Myriad Family History Tool**: YES, YES, YES, NO, YES, YES, NO, NO, YES, NO, NO, YES, NO, NO, YES
- **Progeny/Ambry**: YES, YES, YES, NO, YES, YES, NO, NO, YES, YES, YES, PARTIAL, NO, NO, YES
- **CancerGene Connect/Invitae**: YES, YES, YES, NO, NO, NO, NO, NO, YES, YES, YES, NO, YES, NO
- **CancerIQ**: YES, YES, YES, NO, YES, YES, YES, NO, YES, YES, NO, NO, NO, NO, YES

*Vanderbilt University Medical Center*
MeTree FHH Platform

• Patient-facing risk assessment and clinical decision support program
• Facilitates uptake of guidelines
• Risk stratification enables precision and population medicine
• Improves quality of care
• Encourages learning and shared decision making

• As part of IGNITE:
  • Demonstrated feasibility in Primary Care practices
  • High patient and provider acceptance
  • Integrated with EPIC EHR system

• SMART-on-FHIR capabilities
• Developers: Lori Orlando, MD and Geoff Ginsberg, MD Duke University
Patient risk profile – report for the patient

Talk to your doctor about having a coronary artery calcium test, because your risk for heart disease may be higher than it seems due to:
- Your having had one or more relatives with heart disease at age <60
- Your heart disease risk level is low

Talk to your doctor about testing for a genetic cause of blood clots (inherited thrombophilia). There’s an increased chance that blood clots run in your family due to:
- Your having had a blood clot at age <50

Talk to your doctor about breast cancer screening by breast MRI (magnetic resonance imaging) and mammograms due to:
- Your having a family history of cancer that increases your chance of getting breast cancer.

For more information, visit Frequently Asked Questions About Genetic Counseling or download the genetic alliance guide Making Sense of Your Genes.
Patient risk profile – report for the provider

<table>
<thead>
<tr>
<th>Risk indicators</th>
<th>Recommended actions</th>
<th>References</th>
<th>NNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiovascular Disease</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Additional MedlinePlus information is available with a mouse-over to help the patient enter high quality data.
Implementation Science

- Structured approach for integrating a new program or protocol into a complex system
- Study of methods to promote the adoption and integration of evidence-based practices, interventions and policies into routine health care and public health settings (nih.gov)
- Process of analysis, implementation, and refinement
- Two implementation science projects
  - eMERGE-MeTREE Pre-implementation FHH project – nearly complete
  - U01 Moonshot proposal – funded!
eMERGE – MeTree FHH Pre-implementation Project

• 3 eMERGE sites and Duke University
  • Multiple investigators from:
    • Vanderbilt VGER parent (Roden, Denny; Wiesner)
    • Geisinger (M. Williams, Adam Buchanan)
    • Northwestern (M. Smith)
    • Duke (L. Orlando and G. Ginsburg)

SA1: Create a pre-implementation assessment plan using the CFIR method for integrating the MeTree patient facing FHH collection tool into diverse EHR systems.

SA2: Develop an implementation guide for the integration of FHH into the EHR.

SA3: Demonstrate the ability to integrate FHH-driven risk assessment in EHR test systems.
The Consolidated Framework for Implementation Research (CFIR)

Outer Setting
- Patient needs & resources
- Cosmopolitanism
- Peer pressure
- External policy & incentives

Inner Setting
- Structural characteristics
- Networks & communications
- Culture
- Implementation Climate
- Readiness for implementation

Individuals’ Characteristics
- Knowledge & beliefs about the intervention
- Self-efficacy
- Individual stage of change
- Individual identification with organization
- Other personal attributes

Intervention Characteristics
- Intervention source
- Evidence strength & quality
- Relative advantage
- Adaptability
- Trialability
- Complexity
- Design quality & packaging
- Cost

Process
- Planning
- Engaging
- Executing
- Reflecting & evaluating

http://cfirguide.org/
Key Informant Interviews (n=60)

• 29 item structured interview guide
• Interviews by phone or F2F - 45 min to 60 min
• Transcribed analyzed and coded for content
  • Transcriptions nearly completed for all interviews
  • Structural coding has begun with completion date 3/31
  • Content coding to commence
• Interim impressions
  • Positive responses tempered with caution about complexity of any integration
Key Informant Domains
(N= 60; Interviews/Domains)

• State and local regulations 7
• Policy makers 4
• Laboratories 3
• Research 8
• Health system leadership 11
• Biomedical Informatics 11
• Hospital administrators/Finance 3
• Providers 12
• Support staff 1
Early Lessons from Stakeholders

• Positive response incorporating FHH
  • “So I think it would be especially helpful for other providers and that’s exciting for me, to everyone be thinking about family history more.”
  • “I think it can be very important because as people might change clinicians or . . . because the electronic health record is kind of the institutional memory”
  • “And so the fact that if we could enter it once and it would be available to everyone in a way that’s pretty easy to access . . .”

• Cautious responses raised about complexity
  • “[You] have solved 2 problems and created 20”
  • “. . . there’s definitely some work arounds that have sort of grown organically out of the difficulty with the structured data input of the history activity”
  • “There are always initiative on resource constraints. I think that the biggest impediment in my mind would be making sure that it’s approved by the patient engagement governance.”
Early Lessons - Technical

• **Must get “buy-in” from key leaders**
  • Resource and informatic needs of the implementation
  • Strategic plans for institution

• **Building “sandbox”**
  • Technical hurdles
  • Each site is using a different version of the Epic EMR
  • Informatic architecture at each site differs

• **For Institutions**
  • Identify site-specific issues
  • Site specific configuration will be necessary
  • Empower “Champion”
Technical Review of Sites

• Perform a multi-domain technical assessment of requirements
  • Duke has met with Vanderbilt, Geisinger and Northwestern EHR teams
  • Identified unanswered technical questions from existing documentation
  • Duke revised the guide based on site feedback, produced v1 Epic Configuration Guide

• Highlighted issues:
  • All 3 sites are on different versions of Epic (2015, 2016, 2017)
  • All 3 sites had an Epic EHR upgrade during the project period
  • Able to send data from EHR to MeTree (“read” capabilities)
  • Not able to develop “write” capabilities due to lack of standards and the current level of Epic support
Aim 3 – Feasibility with Test Environment

• Demonstrate the feasibility of MeTree-EHR integration
  • Northwestern Medicine team is working through v1 Epic Configuration Guide in development environment
  • (Lead Luke Rasmussen)
  • Resolving questions with Duke team as they arise in the process
  • Evaluating SMART-on-FHIR as cross-platform implementation (looking at publication on findings)

• Lessons learned
  • Success is highly dependent upon the perceived need at each institution and will set the priority
  • Competing demands on technical staff
  • Lack of complete interoperability may delay implementation
Implement Platform in Clinic

• **Moonshot U01:**
  • Improving identification and healthcare for patients with Inherited Cancer Syndromes: Evidence-based EMR implementation using a web-based computer platform (CoPIs: Wiesner and Orlando)
  • Implementation science design to develop and deploy FHH platform in clinical care
  • Diversity of across several domains
    • clinic, institution, and patient
    • Deploy in VUMC and Meharry clinics
  • Just funded; awaiting NOA;
  • 5 years, start date this fall....
Fig 1 Barriers and solutions to providing healthcare to patients at risk for inherited cancer syndromes

**BARRIERS**
- Limited time in clinic to obtain FHH
- Lack of EMR integration
- Limited access underserved populations
- Limited GC workforce
- Lack of GC in patient’s area
- Lengthy counseling time
- Risk algorithms separate from EMR
- Upload pedigree flat pdf file
- Family members geographically distant
- Need for specialist care

**WORKFLOW**
- **Patients with cancer**
  - Early age at diagnosis
  - Multiple primary cancers
  - Tumor sequencing with a possible germline gene defect
- **Patients with a family history of cancer**
  - Spectrum of cancers in relatives suggestive of syndrome
  - Relative with gene defect

  **Genetic counseling and testing**
  - Gene defect found
  - Gene defect not found

  **Cascade testing family members**
  - High risk management
  - Low to moderate risk management

**SOLUTIONS**
- Patient – facing FHH
  - CDS support for HCP
  - SMART-FHIR link to EMR
  - Integrate HCP clinical workflow
  - Review molecular tumor tests
- Pre-appointment patient education
  - Integration of FHH with GC clinical workflow
  - Telegenetics
  - CDS support
- Use of FHH system to facilitate communication
  - Telegenetics
  - Educational support
## RE-AIM Framework

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Criteria Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reach</strong></td>
<td>number (%) and representativeness of the eligible intervention population</td>
</tr>
<tr>
<td><strong>Effectiveness</strong></td>
<td>number (%) of participants identified by intervention</td>
</tr>
<tr>
<td><strong>Adoption</strong></td>
<td>number (%) and representativeness of the participating intervention sites</td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td>the extent of intervention delivery as intended (integrity) and frequency of use (exposure)</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td>costs to implement and maintain vs effectiveness</td>
</tr>
</tbody>
</table>

[http://re-aim.org](http://re-aim.org)
U01 Moonshot Specific Aims

• **SA1.** Deploy a care delivery model that will facilitate systematic risk assessment for hereditary cancers in diverse clinical environments.
  - 4000 participants will be enrolled and randomized to usual care or MeTree FHH risk assessment
  - Deploy in academic medical center (VUMC) and low income community medical center (MMC)
  - Assess participants perceptions using online survey and qualitative semi-structured interviews

• **SA2.** Improve access to genetic healthcare providers for participants at risk for hereditary cancer syndromes.
  - 300 high risk participants in the VUMC Hereditary Cancer Clinic will be enrolled and randomized
  - Extend clinic capacity by lessening the need for in-clinic family history collection and basic counseling
  - Expand reach of clinic by using telephone and video genetic counseling; referral to specialists

• **SA3.** Explore the feasibility of our care delivery model to improve family engagement for cancer risk assessment
  - Participants extend invitations to MeTree’s family resource center to share results of genetic tests
  - Assist with education and referral needed for cascade testing for pathogenic variants
Workflow for Identification of High Risk Patients

Patient portal

Email offering use of MeTree
- e-randomized
- Usual care

Consent and View Patient Education Video
- Usual care join later

High risk referral to clinic

Participant choice of in clinic or tele health

Metrics
-- approached
-- uptake of MeTree
-- uptake of GC

Surveys
-- provider
-- participant
SA1. Protocol for MeTree FHH risk assessment for inherited cancer syndromes

1. Recruit Primary Care, Cancer Clinics, Patient Portal
2. Enroll N=4000
3. e-Randomize
4. Usual Care N=2000
5. MeTree Risk Assessment N=2000
6. High Risk N=400
7. Delayed MeTree (one year)
8. Genetic Counseling (SA2)

SA2. Protocol for genetic counseling visits after MeTree FHH risk assessment for inherited cancer syndromes (Specific Aim 2).

1. Usual Genetic Counseling Referrals
2. Usual Care N=150
3. MeTree High Risk (SA1) N≈400
4. Schedule Appointment: Participant Choice
5. In Clinic Counseling and Testing
6. Telegenetics Counseling and Testing
<table>
<thead>
<tr>
<th>Table 1. Data elements used to measure the implementation of FHH risk assessment for inherited cancers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Access to MeTree (SA1-3)</strong></td>
</tr>
<tr>
<td>Smartphone</td>
</tr>
<tr>
<td>Tablet</td>
</tr>
<tr>
<td>Desktop</td>
</tr>
<tr>
<td>Library</td>
</tr>
<tr>
<td>Study device</td>
</tr>
<tr>
<td>Family/Friend</td>
</tr>
<tr>
<td>If assistance is needed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2. This proposal will utilize the RE-AIM Framework for Implementation Science projects (93)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Criteria</strong></td>
</tr>
<tr>
<td>Reach</td>
</tr>
<tr>
<td>Effectiveness</td>
</tr>
<tr>
<td>Adoption</td>
</tr>
<tr>
<td>Implementation</td>
</tr>
<tr>
<td>Maintenance</td>
</tr>
</tbody>
</table>
Figure 1: Implementation planning is simultaneously both sequential and non-linear.
Summary

Next generation sequencing
Cost decreasing
Increased indication

Informatic solution
Linked with EHR
Acknowledgements

- Vanderbilt University Medical Center
  - Trent Rosenbloom
  - Andrea Ramirez
  - Jeremy Warner
  - Josh Peterson
  - Sarah Bland
  - Catherine Hammack
  - Kathleen Brelsford
  - Dan Roden
  - Josh Denny
- Duke University
  - Lori Orlando
  - Geoff Ginsberg
  - Teji Rakhra-Burris
- Meharry Medical College
  - Sid Pratap
- Northwestern University
  - Maureen Smith
  - Luke Rasmussen
- Geisinger
  - Adam Buchannan
  - Alanna Rahm
  - Nephi Walton