Cancer Genetics and Prevention: Nursing Practice and Science Implications

Meghan Underhill-Blazey, PhD, APRN, FAAN

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Objectives

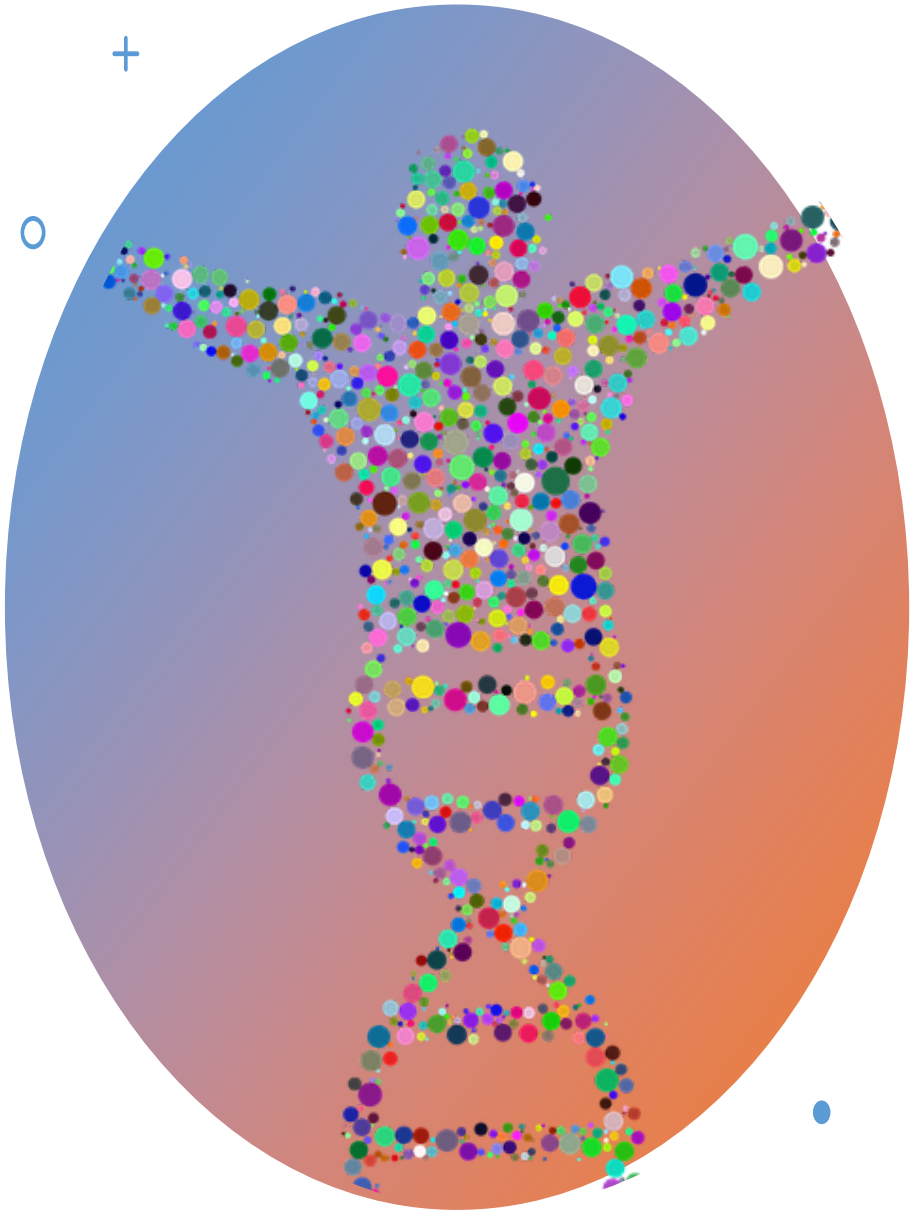
1. Synthesize patient reported experiences of living with hereditary cancer risk across multiple hereditary cancer domains.

2. Explore patient focused interventions aimed at supporting patients and families living with high risk for hereditary cancer.

3. Describe nursing focused education, practice, and research opportunities to improve the psychosocial support of individuals living with high risk for hereditary cancer.

Program of Research

- **Goal:** Improve the experience of persons and families living with increased risk for cancer through innovative technology-based health promoting interventions.
  - What is the meaning and experience of living with cancer predisposition?
  - How do at-risk individuals and families engage in self-care?
  - How can nursing science best support at-risk individuals and families to effectively utilize cancer risk related information to promote health?
  - How can research, policy, and practice initiatives improve the experience of persons living with cancer risk?



Why is Cancer Genetics and Prevention an important area for Nursing Practice and Nursing Science?


TIME
INSIDE
A Day With Jimmy Carter
The DNA Furor
TINKERING WITH LIFE
SPECIAL REPORT
TIME
Genetics
THE FUTURE IS NOW
New breakthroughs can cure diseases and save lives, but how much should nature be engineered?
TIME
IRAQ'S POWER BROKER
PIXAR'S INCREDIBLE NEW MOVIE
THE GOD GENE
Does our DNA compel us to seek a higher power? Believe it or not, some scientists say yes
PLUS: A quiz—How spiritual are you?
TIME
THE FUNNIEST MAN IN AMERICA
What scientists have uncovered about HOW MEMORY WORKS and how to improve it
THE I.Q. GENE?
Egypt Divided / Pot's Big Moment / Best of 2012
Movies, Music, Books & More
TIME
Want to Know My Future?
Alzheimer's
Dementia
Asthma
Diabetes
Cancer
Homochromatosis
Cystic fibrosis
Colon cancer
Breast cancer
Tay-Sachs disease
Huntington's disease
Epilepsy
Burkitt's lymphoma
Parkinson's
Malignant melanoma
Glaucoma
Prostate cancer
Obesity
New genetic tests can point to risks—but not always a cure
BY BONNIE ROCHMAN
Joe Klein: The CIA's Afghan Disaster
Yemen: The New Center Of Terror
Why the Recession Hasn't Been Cool To Teens
TIME
WHY YOUR DNA ISN'T YOUR DESTINY
The new science of epigenetics reveals how the choices you make can change your genes—and those of your kids
BY JOHN CLOUD
TIME
HUMAN CLONING IS CLOSER THAN YOU THINK
For couples who can't have a child—or who have lost one—the unthinkable may soon be possible. Here are the perils
EXCLUSIVE Q&A
DR. LAURA ON THE OFFENSIVE
J. Craig Venter
Francis Collins
The inside story of how these bitter rivals mapped our DNA, the historic feat that changes medicine forever
Cracking The Code!
CELERA

Selected genetics milestones that impact practice

1948: Creation of the American Society of Human Genetics

1957: Johns Hopkins establishes the Division of Medical Genetics- Dr. Victor McKusick

1963: Newborn screening begins

1966: Prenatal screening begins

1970: First genetic counseling program at Sarah Lawrence College

1990 new technology allows for pre-symptomatic genetic testing

1990-2003: Human genome project begins

1993: Huntington disease gene identified; Lynch Syndrome genes discovered

1994: BRCA1 discovered

1996: BRCA2 discovered

2008: GINA signed into law (Genetic Information Nondiscrimination Act)

2008: Genetics added to the essentials of nursing practice

2011: clinical exome testing developed; cell-free DNA for prenatal testing

2012: the first multigene cancer panels become available

2014: US supreme court strikes down human gene patents, allowing multiple labs to provide testing at a reduced cost

2015: 23 & Me begins

https://www.nsgc.org/About/About-NSGC/Timeline

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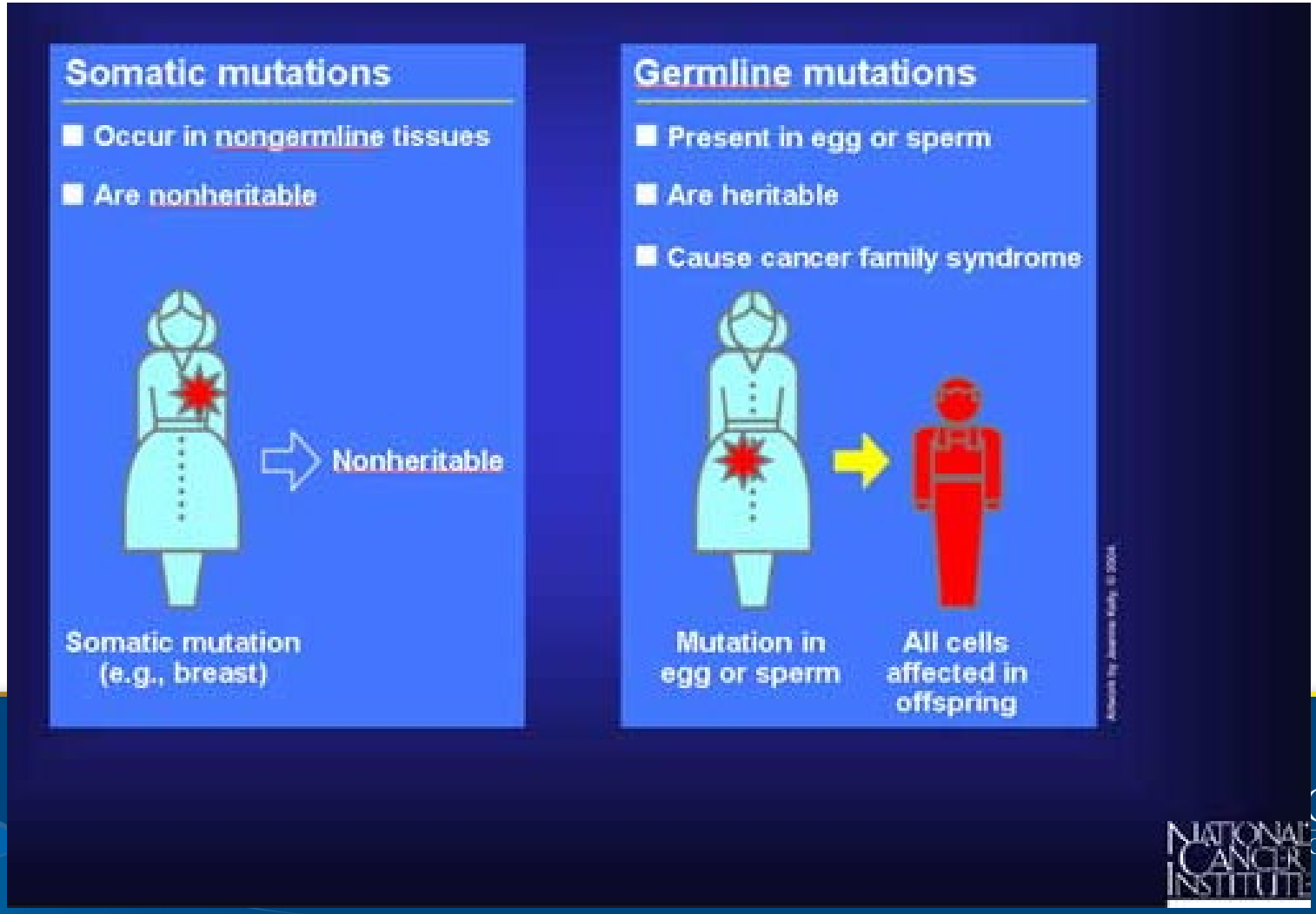
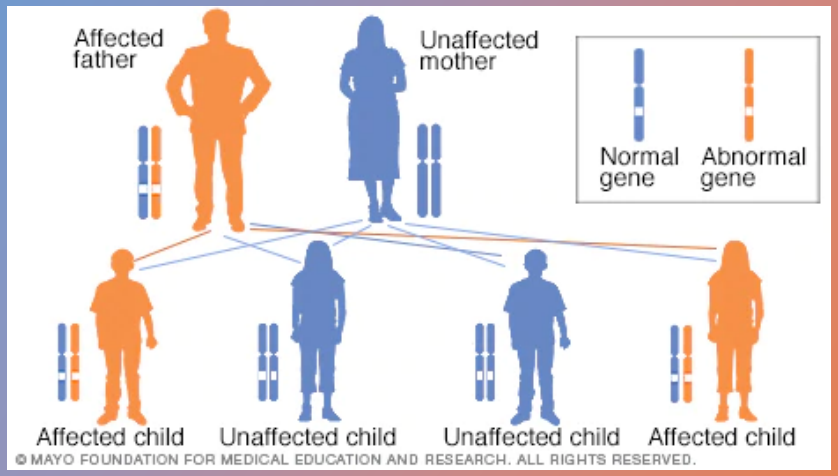
Genetics and Cancer

- Cancer is a genetic disease
- Some genetic changes can be inherited (germline) or acquired after conception (somatic)



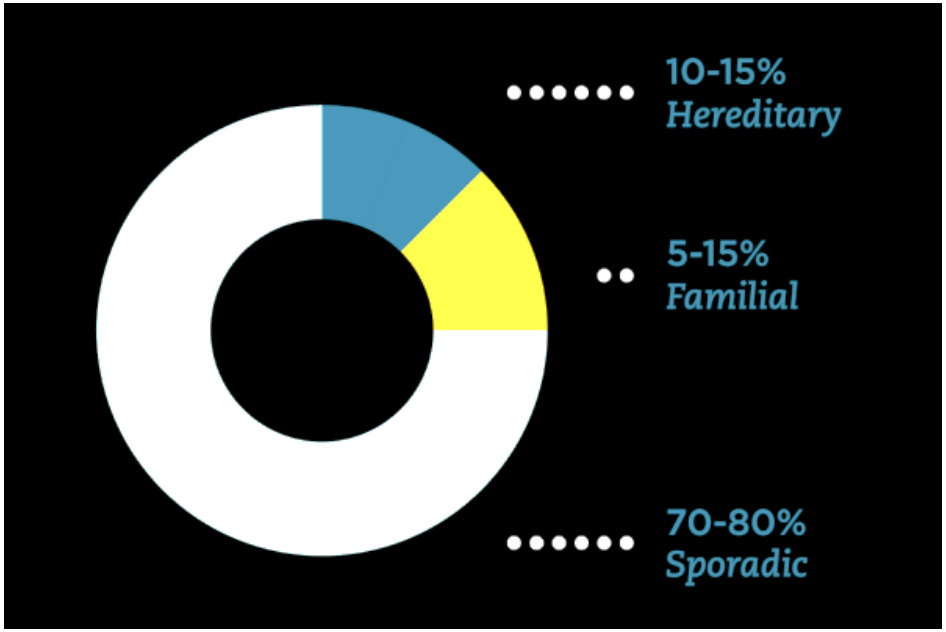
Inherited cancer risk



- We are born with many genes that are associated with cancer
  - Born with two copies
  - One from biological father and one from biological mother
  - When they are working they actually stop cancer from occurring!
- If a person is born with a copy of the gene that doesn't work, "**pathogenic variant**", cancer may occur more frequently or at a younger age
- These abnormally working genes can be passed down within families; called **inheritance**

How common is inherited cancer risk?

- Most cancers are “sporadic”
- Inherited risk for cancer is rare, however, if a person carries an abnormal gene associated with cancer they may be at increased risk for developing cancer themselves
- Having a genetic risk for cancer is NOT a diagnosis of cancer, it is a marker for increased risk over the course of a persons lifetime.
- Family members may also have risk



Red flags for cancer risk

- Diagnosed with cancer at age 50 or younger
- More than one primary cancer in same individual
- Multiple family members (more than 2) on the same side of the family diagnosed with cancer
- Pancreatic cancer
- Ovarian cancer
- Male breast cancer
- Breast cancer under age 45, triple negative, or metastatic
- Metastatic prostate cancer
- MMR deficient colorectal cancers

Professional guidelines for referral: Genetic counseling and testing

- National comprehensive cancer network (NCCN)
- American Society of Clinical Oncology (ASCO)
- Oncology Nursing Society (ONS)
- American Society of Breast Surgeons (ASBS)
- American College of OBGYN (ACOG)

Many people diagnosed with cancer are recommended cancer genetic testing and should be informed and the list is growing every day!

What is genetic counseling?

"Genetic Counseling is the process of helping people understand and adapt to the medical, psychological and familial implications of genetic contributions to disease."

Multiple models for health care delivery

Approaches to Genetic Testing

Genetic Testing

Single Gene Testing

Gene Panel Testing

Hereditary Cancer Next-Gen Panels by Gene

GENES	BreastNext	OvaNext	ColoNext	CancerNext
ATM	•	•		•
BARD1	•	•		•
BRIP1	•	•		•
MRE11A	•	•		•
NBN	•	•		•
RAD50	•	•		•
RAD51C	•	•		•
PALB2	•	•		•
STK11	•	•	•	•
CHEK2	•	•	•	•
PTEN	•	•	•	•
TP53	•	•	•	•
CDH1	•	•	•	•
MUTYH	•	•	•	•
MLH1		•	•	•
MSH2		•	•	•
MSH6		•	•	•
EPCAM		•	•	•
PMS2		•	•	•
PMS1		•	•	•
APC			•	•
BMPR1A			•	•
SMAD4			•	•

Multigene Cancer Panel Testing: Standard of Care

- Simultaneously test for roughly 40-80 cancer susceptibility genes (or more!) compared to syndrome or gene specific testing
- Include genes of moderate, high penetrance
- Multiple commercial panels are available – organ specific vs pan-cancer
- Panels are constantly changing

Genetic Testing Results

- Positive
  - Medical management implications for individual and family
- Negative
  - Uninformative versus true negative
- Variant of Uncertain Significance
  - Change was found but meaning *unknown*
  - No medical management implications unless reclassified
  - 30% of all panel test results will have a VUS

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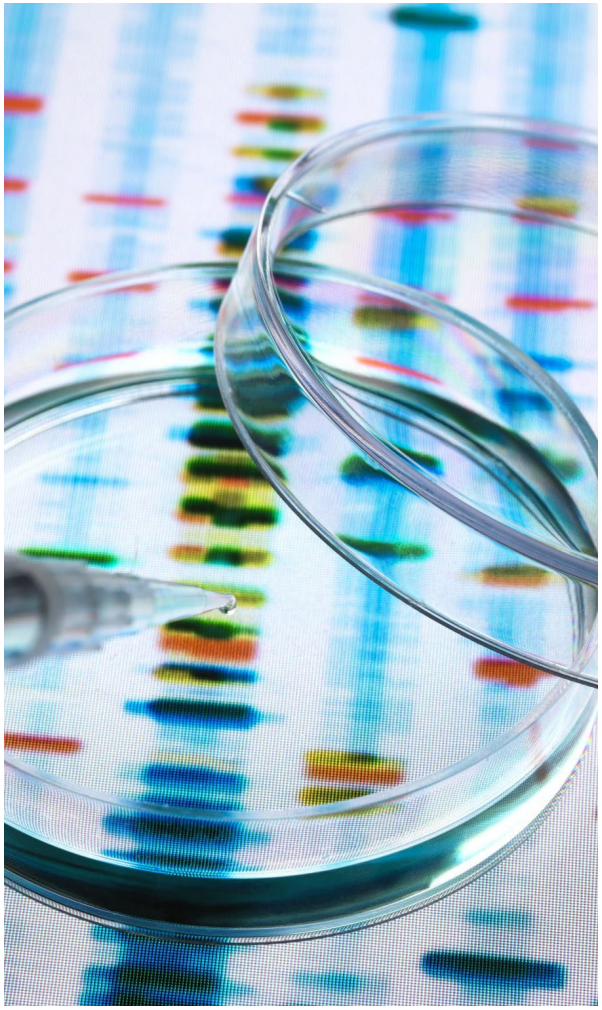
Impact of Positive Test on the Family

- Blood related relatives should be offered genetic testing due to medical management recommendations (i.e. cascade testing)
- Majority of at-risk relatives may not know of risk and of those who do uptake of testing occurs in <50%
- Barriers cited in the literature include lack of family communication, lack of closeness to specific family members; lack of knowledge of how to communicate genetic testing results; access to testing



Genetic discrimination

- Genetic Information Non-Discrimination Act (GINA) 2008
- GINA protects individuals against workplace or insurance discrimination connected to genetic information in an individual or family. The law does not cover military, life, long-term, or disability insurance.
- States have laws that protect individuals' and families' genetic information, and practitioners should be aware of protections unique to the patient population served.

Underhill-Blazey, M. L.. & Khlem, M. (2020). Genetic Discrimination: The Genetic Information Nondiscrimination Act's Impact on Practice and Research. Clinical Journal of Oncology Nursing Number 2/April 2020, 24(2), 135-137.

Insurance coverage and cost

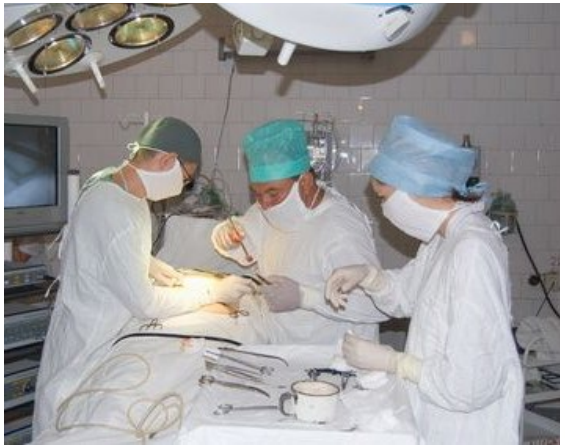
- For eligible individuals insurance typically covers genetic testing.
  - There may be a co-pay for the counseling visit
  - May have a deductible
- For those who are uninsured, laboratories have financial assistance plans
  - May be a cost for counseling visit

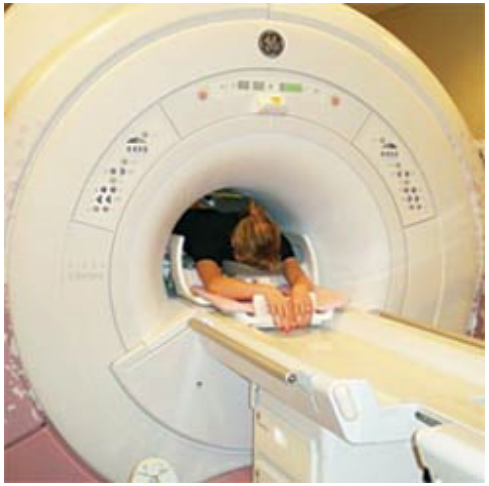
The role of inherited genetic information in cancer care

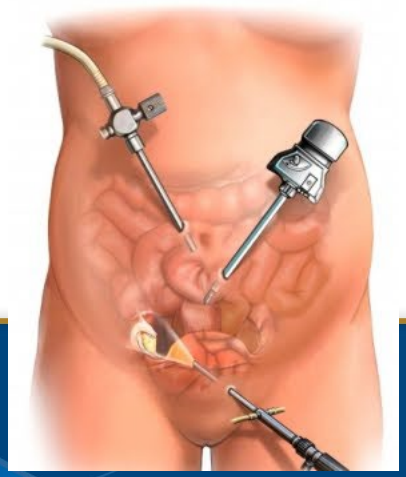
- Hereditary cancer care is focused on the **individual** and **family** and is relevant across the spectrum of cancer care.
  - **Prevention**: lifestyle, medication, surgery
    - Chemoprevention; prophylactic organ removal; lifestyle
  - **Early detection**: high risk screening/surveillance
    - Breast MRI; EUS pancreas
  - **Treatment**: targeted therapies
    - PARP Inhibitors in ovarian cancer; pancreatic cancer
  - **End-of-life:** family implications; caregiving support for at-risk relatives

(Daly et al, 2016; Gues et al, 2016)

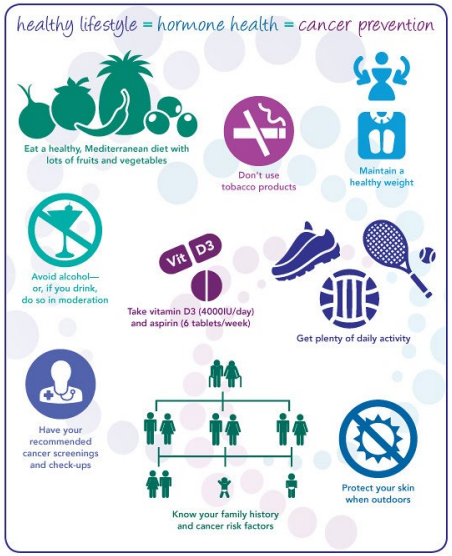
This leads to multiple health decisions…







What actions are taken based on results?



Cancer Prevention & Risk Reduction

Healthy lifestyle changes
Chemoprevention
Prophylactic surgeries

Cancer Screening

Start at younger age
More often
More specific

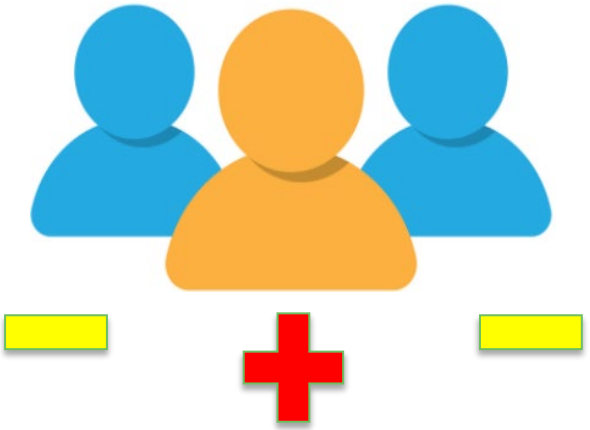
Target Therapy & Treatment Decisions

Surgical decision making
Systemic treatment selection

Pancreatic cancer as an example

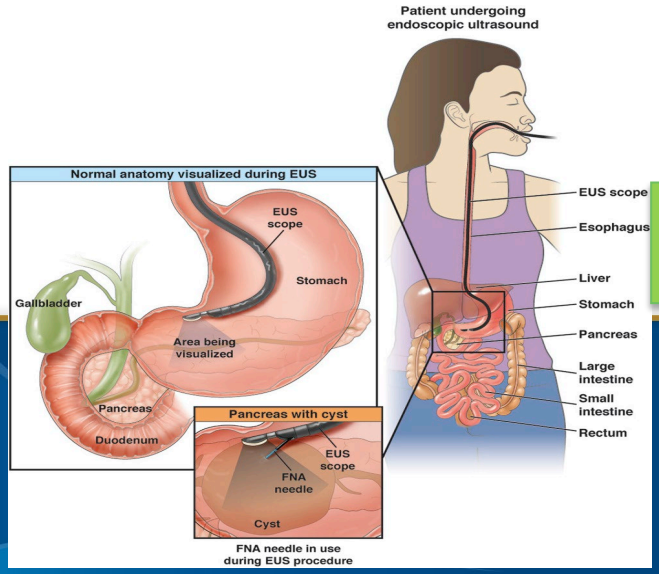
Pancreatic Cancer Diagnosis

Genetics Referral



Targeted therapy

Pancreatic Cancer Surveillance

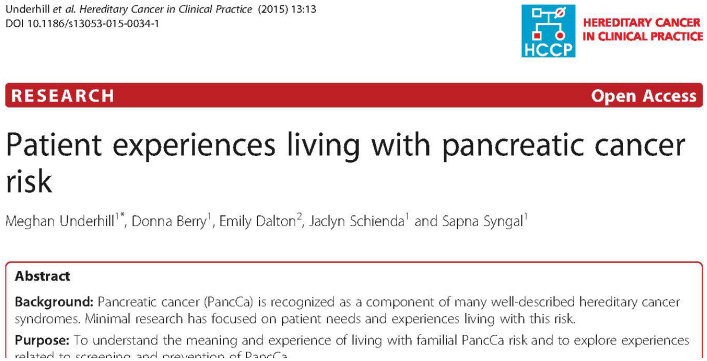


Live-Saving Surgery

How does this make patients feel?

- Overall, genetic testing has not been shown to lead to **pathologic** anxiety or depression.
- However, the absence of pathology does not indicate that an individual does not have concern or perceive an impact of learning genetic results.
- Though anxiety and depression are not commonly associated with genetic testing results, higher risk perception, cancer worry, and uncertainty do occur, especially in those with a positive genetic finding.

(Vos, van Asperen et al. 2013); (Ringwald, Wolfinnowski et al. 2016); (Lumish, Steinfeld et al. 2017)



Underhill *et al. Hereditary Cancer in Clinical Practice* (2015) 13:13
DOI 10.1186/s13053-015-0034-1

HEREDITARY CANCER IN CLINICAL PRACTICE

RESEARCH Open Access

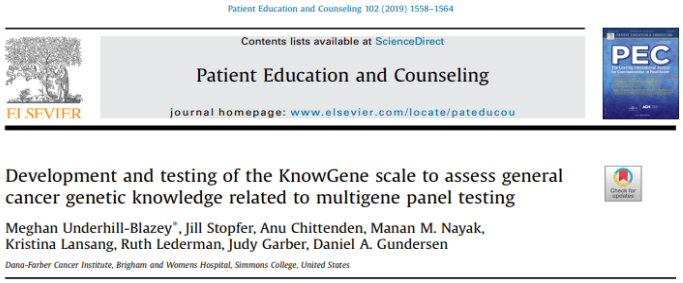
Patient experiences living with pancreatic cancer risk

Meghan Underhill[1*], Donna Berry[1], Emily Dalton[2], Jaclyn Schienda[1] and Sapna Syngal[1]

Abstract

Background: Pancreatic cancer (PancCa) is recognized as a component of many well-described hereditary cancer syndromes. Minimal research has focused on patient needs and experiences living with this risk.

Purpose: To understand the meaning and experience of living with familial PancCa risk and to explore experiences related to screening and prevention of PancCa



Patient Education and Counseling 102 (2019) 1558–1564

Contents lists available at ScienceDirect

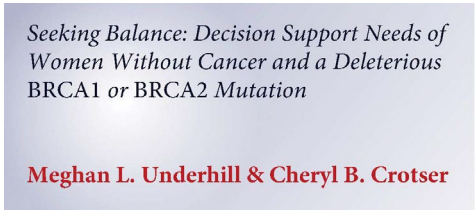
Patient Education and Counseling

journal homepage: www.elsevier.com/locate/pateducou

Development and testing of the KnowGene scale to assess general cancer genetic knowledge related to multigene panel testing

Meghan Underhill-Blazey*, Jill Stopfer, Anu Chittenden, Manan M. Nayak, Kristina Lansang, Ruth Lederman, Judy Garber, Daniel A. Gundersen

Dana-Farber Cancer Institute, Brigham and Womens Hospital, Simmons College, United States



Seeking Balance: Decision Support Needs of Women Without Cancer and a Deleterious BRCA1 *or* BRCA2 *Mutation*

Meghan L. Underhill & Cheryl B. Crotser

BEHAVIORAL MEDICINE
2016, VOL. 0, NO. 0, 1–9
http://dx.doi.org/10.1080/08964289.2016.1138925

Routledge Taylor &

Perceptions of Cancer Risk, Cause, and Needs in Participants from Low Socioeconomic Background at Risk for Hereditary Cancer

Meghan L. Underhill, PhD, RN, AOCNS[a], Karleen R. Habin, RN, MSN[b], and Kristen M. Shannon, MS, CGC[c]

[a]Dana-Farber Cancer Institute; [b]Massachusetts General Hospital, Cancer Resource Foundation; [c]Massachusetts General Hospital

Cancer Medicine

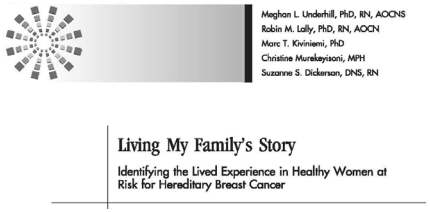
Open Access

ORIGINAL RESEARCH

A state-wide initiative to promote genetic testing in an underserved population

Meghan L. Underhill[1], Traci M. Blonquist[1], Karleen Habin[2,5], Debra Lundquist[3,5], Kristen Shannon[2], Kathryn Robinson[4], Mary-Lou Woodford[5] & Jean Boucher[6,1]

[1]Dana-Farber Cancer Institute, 450 Brookline Ave LW522, Boston, Massachusetts, 02115
[2]Massachusetts General Hospital, Boston, MA, USA
[3]Boston College, Connell School of Nursing, Cancer Resource Foundation, Chestnut Hill, MA, USA
[4]School of Nursing, Northeastern University, Boston, MA, USA
[5]Cancer Resource Foundation, Marlborough, MA, USA
[6]Graduate School of Nursing, University of Massachusetts Medical School, Worcester, MA, USA



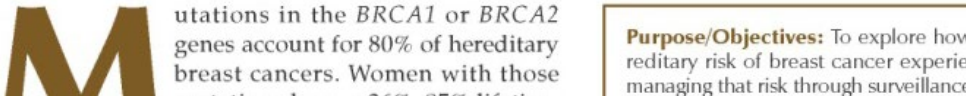
Meghan L. Underhill, PhD, RN, AOCNS
Robin M. Lally, PhD, RN, AOCN
Marc T. Kiviniemi, PhD
Christine Murekayisoni, MPH
Suzanne S. Dickerson, DNS, RN

Living My Family's Story

Identifying the Lived Experience in Healthy Women at Risk for Hereditary Breast Cancer

Engaging in Medical Vigilance: Understanding the Personal Meaning of Breast Surveillance

Meghan L. Underhill, PhD, RN, AOCNS®, and Suzanne S. Dickerson, RN, DNS



Mutations in the *BRCA1* or *BRCA2* genes account for 80% of hereditary breast cancers. Women with those

Purpose/Objectives: To explore how reditary risk of breast cancer experie managing that risk through surveillanc

Received: 13 September 2017 | Revised: 27 February 2018 | Accepted: 9 March 2018
DOI: 10.1002/pon.4712

PAPER

WILEY

Relationship between individual and family characteristics and psychosocial factors in persons with familial pancreatic cancer

Meghan Underhill[1] | Fangxin Hong[2] | Janette Lawrence[3] | Traci Blonquist[2] | Sapna Syngal[4,5]

Nursing Science is Critical to Understand Patient Experiences and to Improve Outcomes

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Summary of formative study findings

- **"Engaging in medical vigilance"**
  - Hereditary risk of breast cancer involves a change in one's view of life and necessitates engaging in medical vigilance, often making women feel ill when they are otherwise healthy (Underhill & Dickerson, 2011)
- **"Living my family's story"**
  - Healthy individuals living with risk approach risk within the context of the family cancer story, which impacts how they define themselves and engage in self-care (Underhill et al., 2012)
- **"Seeking balance"**
  - Living with hereditary breast and ovarian cancer risk is a dynamic and complex experience of balancing medical recommendations with personal and family values over time (Underhill & Crotser, 2013)
- **"Living with worry and uncertainty"**
  - Inherited cancer risk also leads to risk for more rare cancers such as pancreatic cancer, where the surveillance and prevention guidelines are still emerging. This can lead to fear and uncertainty, especially given the poor outcomes for people diagnosed with pancreatic cancer (Underhill-Blazey et al. 2015; Underhill-Blazey et al. 2018; Underhill-Blazey et al. 2020).

Funding: Sigma Theta Tau, Gamma Kappa Chapter, UE4CA156732

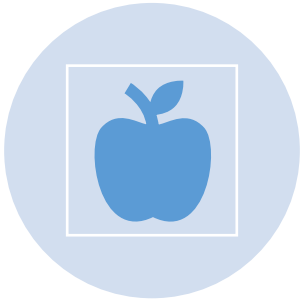
Patient-Driven Findings

- *"I don't worry about hypertension, I don't worry about car crashes. I don't worry about strokes. There's a false positive that gets created, which is, you know, by being twelve or fourteen percent likely to die of pancreatic cancer you get it in your head you are going to die of pancreatic cancer. But the inverse, of course, that there is an 86% chance that you are going to die from something else. But for some reason that is not on my mind…"*
- -40 year-old male, father died of pancreatic cancer, BRCA2 mutation

Underhill M, Berry D, Dalton E, Schienda J, Syngal S. Patient experiences living with pancreatic cancer risk. Hereditary Cancer in Clinical Practice. 2015;13(1):13.

Interventions that are known to be effective…

MINDFULNESS BASED STRESS REDUCTION CAN IMPROVE PSYCHOSOCIAL AND PHYSICAL OUTCOMES FOR INDIVIDUALS AT HIGH RISK FOR CANCER DUE TO A KNOWN BRCA1/2 PATHOGENIC VARIANT



LIFESTYLE AND DIET INTERVENTIONS MAY HELP IMPROVE QUALITY OF LIFE IN PEOPLE WITH APC OR BRCA1/2

THEORY DRIVEN, FAMILY-BASED PSYCHOEDUCATION AND SKILLS INTERVENTIONS CAN IMPROVE COMMUNICATION, KNOWLEDGE, AND SOME PSYCHOSOCIAL OUTCOMES

Underhill-Blazey, M., Rodriguez, D., & Norton, S. A. (2022, May). Scoping Review of Nonsurgical, Nonpharmacologic Interventions After Risk Reduction: Improving Quality of Life for Patients With Inherited Cancer Risk. In Oncology Nursing Forum (Vol. 49, No. 3, pp. 193-200). Oncology Nursing Society.; Baroutsou, V., Underhill-Blazey, M. L., Appenzeller-Herzog, C., & Katapodi, M. C. (2021). Interventions facilitating family communication of genetic testing results and cascade screening in hereditary Breast/Ovarian Cancer or Lynch Syndrome: a systematic review and meta-analysis. *Cancers*, *13*(4), 925.

Summary

- The field of cancer genetics and prevention is rapidly evolving and a part of all of cancer care.
- Genetic testing can contribute to improve cancer prevention and early detection outcomes, as well as improved cancer treatment
- Genetic testing results can lead to a multitude of health decisions that can impact quality of life and may cause worry or uncertainty.
- Interventions that can support those living with high risk for cancer include psychoeducation; mindfulness; social support

Cancer Screening and Prevention

When thinking about inherited cancer risk it is important to not forget about the whole person!

General population recommendations:

- All people undergo breast cancer risk assessment
- Mammogram starting at age 40
- Colonoscopy starting at age 45
- 150 minutes a week of moderate to vigorous activity
- Balanced diet to avoid obesity, minimize red meats & processed foods
- Tobacco avoidance
- Limit alcohol to <3 glasses a week
- Vitamin D levels >30 for cancer prevention
- Sleep and reduced stress are important for well-being!

Clinical Resources

- Oncology Nursing Society: Genetics CNE
- National Human Genome Research Institute: Genomics Competency
- International Society of Nurses in Genetics
- Jackson Labs: Cancer Genetics Clinical Education
- National Comprehensive Cancer Network
- Facing Our Risk for Cancer Empowered
- Lynch Syndrome International
- CDC: Family Health History

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  - Melanie Bobry MS, RN
  - Charles Kamen MD, MPH
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  - Sally Norton PhD, RN, FNAP, FPCN, FAAN
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  - Vivek Kaul, MD
- **Relevant Funding sources**:
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> ***"If I have seen further than others, it is by standing upon the shoulders of giants."***
> -Isaac Newton

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