Implementation of Public Health Genomics & Applications to Oral Health

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Today’s Learning Objectives

• Name three genetic conditions that are relevant to oral health and public health genomics

• Describe a public health approach to determine if a genetic test is ready for implementation at the clinical and/or population level

• List two available public health genomics resources that are useful to dental public health professionals
Vision for Public Health Genomics

“Genomics will be to the 21st century what infectious disease was to the 20th century...

Genomics should be considered in every facet of public health: infectious disease, chronic disease, occupational health, environmental health, in addition to maternal and child health”

...and importantly dental public health!

Gerard et al. Journal Law, Medicine, Ethics 2002; vol 30(suppl):173-176
What is Public Health Genomics?

- A **multidisciplinary** field concerned with the **effective and responsible** translation of genome-based knowledge and technologies to improve population health
  - Bellagio Statement, 2006
Public Health Genomics: Collaboration Among Multiple Stakeholders including Dental Public Health Professionals

Dental Public Health Organizations & Professionals!
“...no important health problem will be solved by clinical care alone, or research alone, or by public health alone- But rather by all public and private sectors working together”

JS Marks. Managed Care 2005;14:p11
Supplement on “The Future of Public Health”
Of the approximately 5,500 known human genetic disorders,
- 30-40% are important to the dental community
- More than 700 are craniofacial disorders
- More than 200 genes involved in the embryogenic development, morphogenesis and differentiation of the teeth
- Chromosome abnormalities, genetic syndromes, and non-syndromic isolated and multifactorial genetic factors
- However, only one dental school requires one semester of molecular biology or genetics for admission (Hart & Hart, 2016)
- Dental schools encouraged to include human genetics as a formal course in curricula

Hart PS & Hart TC, Molecular Genetics and Genomic Medicine, 2016, 123-125
Robert (Bob) Gorlin, DDS, MS, 1923-2006

Gorlin described more than 100 syndromes involving oral pathology, craniofacial genetics, otolaryngology and obstetrics

“In human genetics, we think Bob belongs to us, but the dentists, the pathologists, the dermatologists, the oncologists, the reconstructive surgeons, and the craniofacial specialists all think he belongs to them too.” - Judy Hall
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. This process integrates the following:
  – Interpretation of family and medical histories to assess the chance of disease occurrence or recurrence.
  – Education about inheritance, testing, management, prevention, resources and research.
  – Counseling to promote informed choices and adaptation to the risk or condition.

Resta et al, J Genet Counseling, 2006 Apr;15(2):77-83
Genetic Counseling Specialties

Historically
- Prenatal
- Pediatrics

Adult
- Cancer
- Neurogenetic
- Cardiology
- Psychiatry
- Endocrine
- General

Treatment
- Somatic sequencing/with or without germline to dictate treatment
- Germline sequencing to dictate treatment
- Pharmacogenomics

- Industry
- Laboratory utilization
- Research
- Public Health
FIND A GENETIC COUNSELOR

The Find a Genetic Counselor directory offers access to over 3,300 genetic counselors (US and Canada).

Check with your insurance company to verify coverage of genetic counseling, testing and authorized providers. For more information, visit AboutGeneticCounselors.com.

To start your search, first tell us how you would prefer to meet with a genetic counselor:

- In Person
- By Phone

Additional searches:
- If you are a student, healthcare provider or other individual interested in speaking with a genetic counselor, click here.
- NSGC members are offered an expanded directory that contains additional information for use in searching for colleagues. Access the NSGC Member Directory.
National Society of Genetic Counselors (NSGC) Vision

“Integrating genetics and genomics to improve health for all”

http://www.nsgc.org/page/about-nsgc
• ~324 million people of the United States
• Ensure access to all regardless of race, gender, income, geography, and ability to pay
• Only ~4,000 certified genetic counselors in US (2017)
• Need to engage dental community!
  – 61 dentists practicing per 100,000 US population (2017)
  – In Texas, ~10,451 licensed general dentists, 12,971 licensed dental hygienists, 35,784 registered dental assistants!

http://www.aha.org/research/rc/stat-studies/fast-facts.shtm
Please Consider Connecting with Your Local Genetics Clinic or Genetic Counselor!

- Consider developing partnership between dental public health and genetics professionals at the local level
- Consider contacting your local genetics clinic
- In Texas, there are ~30 genetic clinics and ~100 genetic counselors; typically located in academic centers in larger cities
  - Some have outreach clinics and services available in rural and underserved areas in Texas

https://www.acmg.net/ACMG/Genetic_Services_Directory_Search.aspx
Referrals to Genetics Services Based on Dental Findings

- Dental public health professionals can help to assure access and appropriate health management of individuals with genetic conditions
- Consider contacting local genetic services to discuss possible appropriate referrals
- Steps to consider for routine genetics evaluation for dental health professionals:
  - Collect and evaluate family and medical history
  - Consider unusual dental findings and associations with other conditions (e.g., oligodontia and colon cancer, enamel defects and kidney disease, microdontia and deafness)
  - Consider routinely collecting genetic conditions with potential oral health implications
  - Consider referral to genetic counselor or other specialists when appropriate
  - Include dental health professionals as part of personalized medicine team/multidisciplinary genetic specialty clinic
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

Precision Public Health

• Rapidly evolving field; no uniform definition
  • Term first used in 2016

• Recent proposed definitions:
  • The application and combination of new and existing technologies, which more precisely describe and analyze individuals and their environment over the life course, to tailor preventive interventions for at-risk groups and improve the overall health of the population
  • “Right intervention at the right time, every time to the right population”
  • Emphasizes interventions; data and informatics

Weeramantrhi et al, Frontiers in Public Health, 2018
Khoury et al, AJPM, 2016
The traditional population health perspective on screening & prevention: one size fits all
The precision medicine approach to screening & prevention: risk-based paradigm

- General population risk
- Family history
- High risk family history
- Mutation carrier
The 3 Core Public Health Functions

- **Assessment**
  - More “precision” in measuring population health problems
- **Policy Development**
  - Developing the right intervention for the right population
- **Assurance**
  - More “precision” in delivering interventions & addressing health disparities
An Example from Michigan: Building Relationships with Primary Care Health Networks in Michigan Underserved Geographical Areas

Locations of Michigan cancer genetic clinics with board-certified genetic professionals (BRCA Clinical Network) + Counties with higher age-adjusted incidence and mortality of cancers of interest (State Cancer Registry) → Primary care provider engagement and education in underserved counties with higher incidence/mortality

Consider engagement and education of dental public health professionals in underserved counties in Texas with higher incidence/mortality of cancers of interest?

https://statecancerprofiles.cancer.gov/map/map.withimage.php?26&001&020&00&01&01&5&0#results

http://www.jaxge.org/workshops/
CDC Office of Public Health Genomics

http://www.cdc.gov/genomics/
Increase in Number of Genetic Tests:
How many have a sufficient evidence for their use in clinical or public health practice?

- Recent study examined test availability and spending for genetic tests, 2014-2017
- ~75,000 genetic tests on the market with 10 new tests entering the market daily
- ~14,000 tests added in 2014-2017
- 86% single gene tests
- Highest percentage of spending by clinical domain was on prenatal tests and second highest on hereditary cancers

Phillips et al; Health Aff. May 2018; 37(5): 710-717
Key Questions to Consider about Genetic Tests

- How valid and reliable are the genomic tests/services? (analytic validity)
- How well does the test/service predict outcomes? (clinical validity)
- What are the benefits and harms when the test/service is used to influence patient management? (clinical utility)
- How should the medical community, public health, policy makers respond? (ethical, legal, social issues)

https://www.cdc.gov/genomics/gtesting/acce/
Small Number of Tests Known to Save Lives

- Tier 1 Tests per CDC Office of Public Health Genomics
  - Proven analytic validity, clinical validity and clinical utility
  - Can save lives!
  - Often underused in clinical practice

- ~80 genomic tests supported by evidence for use in practice
  - Most are cancer-related tests

- Many intended uses include
  - Diagnosis
  - Prognosis
  - Risk prediction to inform prevention
  - Treatment, including choice of medication and dosage
  - Screening

Centers for Disease Control and Prevention. genomicsforum.org/editoruploads/ActionstoSaveLivesNowReport.pdf
Three-Tier Classification of Recommendations on Genomic Applications

• **Tier 1: Ready for implementation**
  – Demonstrated analytic validity, clinical validity, clinical utility and evidence-based recommendations
  – Health professionals: encourage use; can save lives!
    • Examples: BRCA *(Grade B)*, Lynch syndrome, familial hypercholesterolemia, hypertrophic cardiomyopathy, newborn screening

• **Tier 2: Informed decision making**
  – Adequate information on analytic and clinical validity, promising but not definitive information on clinical utility; no evidence-based guidelines recommending clinical use
  – Health professionals: provide information for shared decision making
    • Examples: Several different pharmacogenomics tests to treat mental illness

• **Tier 3: Discourage use**
  – No or little information on analytic, clinical validity or clinical utility; or evidence of harm
  – **With exception of newborn screening, there are not any genetic tests that should yet be offered to the entire population**
  – Health professionals: discourage use; may be considered for research in select instances; reduce potential harms and save unnecessary healthcare costs
    • Examples: BRCA *(Grade D)*, Population screening for hereditary hemochromatosis

—

Bowen MS et al Public Health Genomics 2012
Healthy People 2020 (HP 2020) Cancer Genomics Objectives

- HP 2020 marks first time for genomics objectives; likely to be included in HP2030
- Increase the proportion of women with a family history of breast and/or ovarian cancer who receive genetic counseling
- Increase the proportion of persons with newly diagnosed colorectal cancer who receive genetic testing to identify Lynch syndrome (or familial colorectal cancer syndromes)
- Estimated that up to 2 million in US have one of these conditions and vast majority are undiagnosed!
- CDC has funded multiple projects to address these HP2020 objectives
  - To my knowledge, none have involved dental health providers
  - Let’s consider adding YOU to these efforts!

http://www.healthypeople.gov/2020/topics-objectives/topic/genomics/objectives
Example of Tier 1 and Tier 3:
2013 USPSTF BRCA-Related Cancer Recommendation
(updated from 2005)

Sufficient evidence to offer counseling & genetic testing for Lynch syndrome to patients newly diagnosed with colorectal cancer to reduce morbidity & mortality in relatives

Relatives of patients who test positive for Lynch could be offered counseling, testing &, if positive, increased colonoscopy

Evidence of benefit to the patient’s relatives
## Three-Tier Classification

### Green
- FDA label requires use of test to inform choice or dose of a drug
- CMS covers testing
- Clinical practice guidelines based on systematic review support testing

### Yellow
- FDA label mentions biomarkers* 
- CMS coverage with evidence development
- Clinical practice guideline, not based on systematic review, supports use of test
- Clinical practice guideline finds insufficient evidence but does not discourage use of test
- Systematic review, without clinical practice guideline, supports use of test
- Systematic review finds insufficient evidence but does not discourage use of test
- Clinical practice guideline recommends dosage adjustment, but does not address testing

### Red
- FDA label cautions against use
- CMS decision against coverage
- Clinical practice guideline recommends against use of test
- Clinical practice guideline finds insufficient evidence and discourages use of test
- Systematic review recommends against use
- Systematic review finds insufficient evidence and discourages use
- Evidence available only from published studies without systematic reviews, clinical practice guidelines, FDA label or CMS labels coverage decision

*Can be reassigned to Green or Red if one or more conditions in these categories apply

[https://phgkb.cdc.gov/PHGKB/topicStartPage.action](https://phgkb.cdc.gov/PHGKB/topicStartPage.action)
Genomics Translation Highway: Discovery to Implementation of Genomics Applications for Population Health Impact

**Genomics Translation Highway: The Public Health Genomics Model**

- **Discovery** (T0)
  - Population Health
  - Effectiveness & Outcomes

- **Bench** (base pairs, etc)
  - Development (T1)
  - Healthcare Systems & Prevention Programs

- **Bedside** (promising tests and interventions)
  - Evaluation (T2)
  - Evidence based Recommendation or Policy

- **Knowledge Integration**
  - Implementation (T3)
    - Khoury MJ et al, AJPH, 2012

- **Knowledge Translation**
  - Practice guidelines to health practice (T3)
  - Practice to population health impact (T4)

**Table 1: The continuum of translational research in cancer genetics: type**

<table>
<thead>
<tr>
<th>Translation research phase</th>
<th>Notation</th>
<th>Examples of types of research</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>Gene and other discoveries</td>
<td>GWASs, candidate gene studies</td>
</tr>
<tr>
<td>T1</td>
<td>Discovery to candidate health application</td>
<td>Phase I and II clinical trials; observational studies to characterize genes and gene-environment interaction; pharmacogenomics</td>
</tr>
<tr>
<td>T2</td>
<td>Health application to evidence-based practice guidelines</td>
<td>Phase III clinical trials; observational studies; evidence synthesis and guidelines development</td>
</tr>
<tr>
<td>T3</td>
<td>Practice guidelines to health practice</td>
<td>Dissemination research; implementation research; diffusion research; phase IV clinical trials</td>
</tr>
<tr>
<td>T4</td>
<td>Practice to population health impact</td>
<td>Outcomes research; population monitoring of morbidity, mortality, benefits, and risks</td>
</tr>
</tbody>
</table>

GWAS, genome-wide association study.
Periodontal Disease: Complex Multifactorial Disease

“In the genomic era, it is not human genes alone but the interplay of multiple genes, epigenetics, the microbial genome and their interactions with oral hygiene, diet, exercise, behaviors and substance abuses that influence the type and severity of periodontal diseases.”

- Harold Slavkin, DDS

Journal of Public Health Dentistry, 2018
Giannobile et al, 2013

Attempted to utilize a precision public health approach to stratify adults into high and low risk categories for periodontitis

- Retrospective study of insurance claims database of over 5,000 adults
- Based on diabetes, smoking and interleukin-1 genotype

Used risk-based results to evaluate tooth loss with 1 vs. 2 annual preventive visits

Initial results appeared to demonstrate clinical utility
- reduce to 1 annual preventive visit for adults with no risk factors
Importance of Critical Review of Precision Public Health Research Prior to Implementation: Interleukin-1 & Preventive Dental Care (continued)

- Diehl et al, 2015
- Re-analyzed initial findings from Giannobile et al study
- No evidence for the interleukin-1 genotype and association with tooth loss
- Results could not be used to reduce preventive dental care by differentiating high and low risk patients
- Need for additional clinical validity and utility studies
- Not a Tier 1 genetic test for use in populations
Scientists agree to disagree on genetic testing

October 14, 2014

By James Berry

An atmosphere of professionalism and cordiality prevailed Oct. 11 in Room 214B at San Antonio’s Henry B. Gonzalez Convention Center — but there was a hint of restrained disagreement in the air as well.

Scientists from academia, research and industry had come together to explore current science and clinical applications for genetic testing in oral medicine. It’s a controversial field of scientific exploration, the controversy resting heavily on questions about the clinical application of genetic tests already on the market.

Welcoming a panel of five experts and an audience of about 200. Dr. Daniel M. Meyer, senior vice president, ADA Division of Science, noted that the morning’s forum was part of a tradition begun several years earlier at the ADA’s annual meeting.

Its purpose, he said, was to bring scientists and clinicians together to “talk about issues where the answers aren’t necessarily clear.”

Strongly countering Dr. Komman’s remarks was Scott Diehl, Ph.D., professor in oral biology and health informatics at Rutgers University, who noted that he had been studying periodontitis and working in the field of genetics for some 30 years.

“It is my pleasure to be here,” he told the audience, “but not my pleasure to report to you that I am forced to disagree with [Dr. Komman’s] conclusions. I do not believe there is any scientific support for the IL-1 genetic test.”

Valid genetic testing for periodontitis may emerge in the future, said Dr. Diehl, but I don’t think we have it yet.”

He also questioned the value of focusing solely on the IL-1 gene. “We have the whole genome to cover, and that we’ve been covering,” he said, adding that thousands of other genes are “biologically relevant” and have “stronger statistical association with disease.”

Concluding the panel presentations, Dr. John Glick, director, Clinical Research Unit, Virginia Commonwealth University School of Dentistry, talked about evaluating the clinical utility and plausibility of genetic testing. He also talked about common risk factors and the importance of plaque control.

There was general agreement among the panelists that genetic testing is a complex topic, especially as it applies to clinical dentistry and medicine. Panel members stressed the need for more education on genetics in dental schools.

Audience members asked a range of thoughtful questions, touching on such issues as the importance of home care, the future of salivary diagnostics and testing for the human papilloma virus.

In the end, differing points of view were fairly aired and professionally received. And the journey of science that Dr. Glick described continued on for another day.

ADA Genetics & Oral Health, 2017 and updated 2019
Example of Core Public Function of Assurance

Oral Health Topics
Genetics and Oral Health
Key Points

- Many common diseases are not inherited as a single gene defect but instead result from gene-environment interactions.
- A predictive test for dental caries or for periodontal disease does not currently exist; both of these are complex diseases with multiple genetic and environmental risk factors.
- No gene to date has been identified that has as large an impact on periodontal disease as do environmental influences, such as smoking or diabetes.
- While genetic testing holds potential for clinical application in the future, clinical measurements remain the best approach for assessment of caries and periodontal disease at this time.


Please check out this excellent resource!
Interleukin-1 & Preventive Dental Care (continued):
Highlights Ethical, Legal and Social Issues (ELSI)

• Commercial genetic testing lab began offering testing based on the Giannobile et al risk-based study
  - Founder of company was one of co-authors
  - Estimated that insurers could save $4.8 billion
  - Both a health plan and large corporation in Michigan had invested in genetic testing company and funded Giannobile study

• Employee wellness plan from both companies decided to include in risk-based benefit plan starting in 2013
  - Employees would receive only one covered cleaning per year unless deemed at high-risk based on genetic test or other risk factors
  - Employees could decline genetic test but then would be limited to one covered cleaning

ADA Policy on Genetic Testing for Payers & Laboratories, 2017

Core Public Health Function of Policy Development

ADA Adopts Policy on Genetic Testing
October 27, 2017

Contact Information:
mediarelations@ada.org

CHICAGO, October 27, 2017 — The American Dental Association at its annual meeting in Atlanta adopted a policy on genetic testing calling on insurers to:

• demonstrate that genetic tests used to determine eligibility for benefit coverage of specific oral health services are scientifically valid;
• disclose financial relationships between manufacturer and payer;
• be transparent about conflicts of interest between the test manufacturer, payer, and study investigators;
• provide independent third party agency confirmation of test validity and reliability for the intended purpose;
• and an analysis of how utilization of the test will affect health outcomes and plan costs.

The policy states, “Health professions will experience a growth of such products and tests in the coming years and [dentists] will need a mechanism to assess the claims and counter claims so that we may best serve our patients and advocate for the needs of the public.”


Gene

Adopted 2017
July 2019: What would you do with this information?

https://www.oraldna.com/
Newer Genomic Technologies: 
Next Generation Sequencing (NGS)

- NGS allows sequencing hundreds to thousands of genes at one time
- Offered by several genetic testing laboratories for clinical and/or research purposes
- Whole Exome Sequencing (WES)
  - Targeted view of the protein-coding regions of the genome
  - Includes ~85% of disease-related variants
- Whole Genome Sequencing (WGS)
  - Analyzes entire genome
- When used for clinical purposes, testing is typically ordered for diagnostic reasons due to suspected genetic etiology based on clinical findings
- Secondary finding
  - Pathogenic findings unrelated to the primary clinical reason for testing
American College of Medical Genetics and Genomics (ACMG) Secondary Findings Recommendations

- Recommends labs report secondary findings when perform clinical exome and genome sequencing tests on list of genes known to cause severe disease and clinically relevant actions available
- List currently includes 59 genes (updated in 2016)
- ACMG working group curate and updates list periodically

### Examples of Secondary Finding Genes to Report with Potential Importance to Dental Public Health Professionals

<table>
<thead>
<tr>
<th>Condition</th>
<th>Gene</th>
<th>Relevance to Oral Health</th>
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<tbody>
<tr>
<td>Adenomatous polyposis coli (FAP)</td>
<td>APC</td>
<td>Teeth and tongue findings could be key to referral for genetic screening/diagnosis</td>
</tr>
<tr>
<td>Peutz-Jegher syndrome</td>
<td>STK11</td>
<td>Mouth features could be key to referral for genetic screening/diagnosis</td>
</tr>
<tr>
<td>PTEN hamartoma tumor syndrome (Cowden syndrome)</td>
<td>PTEN</td>
<td>Teeth and tongue findings could be key to referral for genetic screening/diagnosis</td>
</tr>
<tr>
<td>Long QT syndrome</td>
<td>KCNQ1, KCNH2, SCN5A</td>
<td>Medications and surgical environment for dental procedures</td>
</tr>
<tr>
<td>Malignant hyperthermia</td>
<td>CACNA1S</td>
<td>Medications and surgical environment (general anesthetics and stress) for dental procedures consider</td>
</tr>
<tr>
<td>Loeys-Dietz syndrome</td>
<td>TGFBR1, TGFBR2</td>
<td>Craniofacial features and bifid uvula/cleft palate consider for genetics referral</td>
</tr>
<tr>
<td>Brugada syndrome 1</td>
<td>SCN5A</td>
<td>Surgery complicated and consider avoiding local anesthesia during dental procedures</td>
</tr>
</tbody>
</table>
Familial Adenomatous Polyposis Coli (FAP)

- Accounts for 1% of all colorectal cancers
- Most common hereditary polyposis
- Autosomal dominant
  - 100% penetrance; untreated polyposis leads to ~100% risk of cancer
  - Caused by mutation in APC gene
- Classic FAP: more than 100 adenomatous polyps prior to age 40
  (attenuated FAP less polyps and later disease)
- Risk of other extracolonic tumors: upper GI; desmoids; osteomas (50-90% of patients); thyroid; brain; hepatoblastoma
- Retinal pigmentation (CHRPE)
- Dental anomalies
  - Supernumerary teeth (11-27% of patients with FAP)
  - Unerupted teeth
  - Congenital absence of one or more teeth
- Management: earlier and more frequent cancer screening; prophylactic colectomy typically prior to age 25

The identification of such dental anomalies in the presence of personal and/or family history of cancer could be an important first step in identification of this hereditary cancer—before the onset of cancer for this individual and their family members.
Peutz Jegher Syndrome (PJS)

- Rare autosomal dominant hereditary cancer
- Caused by mutation in STK11 gene
- Diagnostic criteria: confirmed hamartomatous GI polyp with distinctive morphology plus two of the following:
  - Small bowel polyposis
  - Mucocutaneous hyperpigmentation of the buccal mucosa, lips, fingers, toes and/or external genitalia
    - Dark blue to dark brown
    - Present in over 95% of people with PJS
    - Generally appear in childhood; after age 25, may fade and less noticeable
  - Family history of PJS
- ~63% risk of cancer by age 60; increased risk of GI tract cancers (colorectal, pancreatic, esophageal, stomach, small bowel), thyroid, breast, and gynecological cancers
- Management: Earlier and more frequent cancer screening (e.g. baseline colonoscopy and upper GI endoscopy begin at age 8; breast MRI begin at age 25; etc)

Cowden Syndrome (PTEN)

- Autosomal dominant hereditary cancer
- Usually due to mutation in PTEN gene
- Major clinical features: breast cancer; thyroid cancer; endometrial cancer; macrocephaly
- Other cancers include colorectal and renal cancer
- Other clinical features include:
  - Facial papules and trichilemmomas around mouth, eyes and nostrils
  - Papillomatous papules (numerous 1-3 mm smooth white spots on gums and palate)
  - GI hamartomas, lipomas, papillomas
- Management: earlier and more frequent cancer screening; discuss prophylactic mastectomy or hysterectomy

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5134167/
Long QT Syndrome (LQTS)

- Autosomal dominant
- Due to mutations in KCNQ1, KCNH2 or SCN5A genes
- QT prolongation, T-wave abnormalities, ventricular tachycardia/torsades de pointes
- Cardiac events most common from pre-teens through 20’s, but variability
  - Syncope and cardiac events often during exertion or excitement
  - ECG changes are most commonly elicited by physical activity, emotional stress, and certain medications
- Can result in sudden cardiac or unexplained death
  - Typically normal autopsy; postmortem genetic testing, personal and family history is vital in diagnosis
- Treatment: avoidance of specific drugs and intense physical activity and emotional stress; beta-blockers, ICD, surgery
- Dental Preventive Measures: evaluation by cardiac specialist, use of anxiolytic protocols, avoidance of drugs that prolong the QT interval, consider anesthesiologists for procedures in which anxiety and adrenergic stimulation would not be suppressed sufficiently in an ambulatory setting

Karp & Moss, J Am Dental Assoc, 2006
Rochford & Seldin, Anest Prog, 2009
GTR: Genetic Testing Registry

- Provides central location to locate current information about laboratories and genetic tests
  - Purpose
  - Methodology
  - Validity
  - Utility
  - Credentials

The All of Us Research Program
(The Precision Medicine Initiative)

Engage a group of 1 million or more U.S. research participants who will share biological samples, genetic data and diet/lifestyle information, all linked to their electronic health records. This data will allow researchers to develop more precise treatments for many diseases and conditions.

Pioneer a new model of research that emphasizes engaged research participants, responsible data sharing and privacy protection.

Research based on the cohort data will:
- Lay **scientific foundation** for precision medicine
- Help identify new ways to **treat and prevent disease**
- Test whether **mobile devices**, such as phones and tablets, can encourage healthy behaviors
- Help develop the **right drug** for the **right person** at the **right dose**

[https://allofus.nih.gov/](https://allofus.nih.gov/)
Review of Today’s Learning Objectives

• Name three genetic conditions that are relevant to oral health and public health genomics
  – FAP; Cowden; Peutz Jeghers; Long QT syndrome; and several others!

• Describe a public health approach to determine if a genetic test is ready for implementation at the clinical and/or population level
  – Analytic Validity, Clinical Validity, Clinical Utility, ELSI (ACCE); USPSTF; EGAPP; Genomics Translation Highway

• List two available public health genomics resources that are useful to dental public health professionals
  – CDC OPHG website; My Family Health Portrait; Genetic Testing Registry; NSGC and ACMG genetics directories; ADA genetic testing & risk assessment policy statement; ADA Genetics & Oral Health educational resources; All of Us research
Thank you!