July 5, 2016

For years, one of the most frequent questions posed to NHGRI staff members by scientists, members of the press, and the public has been, "How much does it cost to sequence a human genome?" Even now, this is an incredibly relevant question, as human genome sequencing expands from being a research tool and blossoms into a major clinical diagnostic test. To help people grasp the various nuances and complexities associated with this seemingly simple question, NHGRI recently developed a new summary and associated infographic about "The Cost of Sequencing a Human Genome," both of which can be found at genome.gov/sequencingcosts/. These web-based documents aim to clarify some of the (often-confusing) aspects of calculating the costs of generating a human genome sequence; they also nicely complement the data that NHGRI regularly collects and disseminates about genome sequencing costs. I encourage you take a look at these informative new documents!

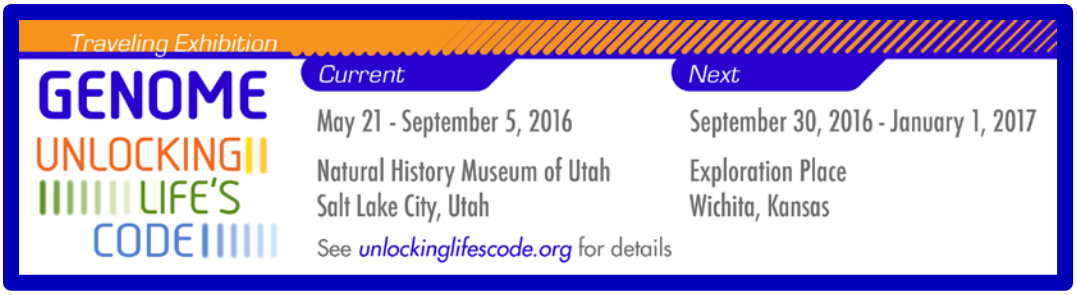
In this issue of *The Genomics Landscape,* we feature the use of model organisms to explore the function of genes implicated in human disease. This month's issue also highlights a recently completed webinar series to help professionals in the health insurance industry understand genetic testing, new funding for training in genomic medicine research, and NHGRI's Genome Statute and Legislation Database.

Specifically, July's *The Genomics Landscape* features stories about:

- The Power of Model Organisms for Studying Rare Diseases
- Webinars for Health Insurers and Payers: Understanding Genetic Testing
- NHGRI Commits to Expanded Training Program in Genomic Medicine
- NHGRI Genome Statute and Legislation Database

All the best,

Watch here for current and upcoming locations of the Smithsonian-NHGRI exhibition "Genome: Unlocking Life's Code" as it tours North America!



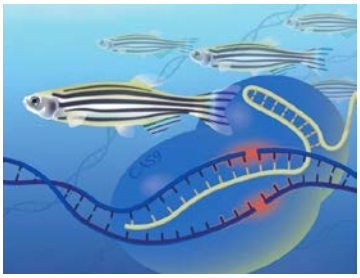
~To manage your subscription to *The Genomics Landscape*, see: list.nih.gov/cgi-bin/wa.exe?A0=NHGRILANDSCAPE~
~To suggest future topics, send an e-mail to: NHGRILANDSCAPE@MAIL.NIH.GOV~
~To access past editions, see: genome.gov/2754196~

The Power of Model Organisms for Studying Rare Diseases

With the human genome consisting of billions of chemical units, scientists have a tremendous amount of information to sift through to understand how the genome works and how it influences human health and disease. Oftentimes, scientists encounter a genomic variant (i.e., an altered spelling) in a gene that they suspect might play a role in a disease being studied. But how do they prove such a relationship? Establishing such 'proof' can be quite challenging. But additional experimentation using model organisms can often provide a key piece of the puzzle.

Over many decades, organisms such as mice, fruit flies, and roundworms have become classic models for studying human biology and disease. Such 'model organisms' reproduce relatively fast and can be readily studied in laboratory settings. As such, scientists use model organisms to conduct experiments that cannot be performed with humans. A typical experiment involves altering a gene of interest in a model organism and seeing if the resulting phenotype mirrors that encountered in humans.

Human diseases are considered rare in the U.S. if they affect fewer than 200,000 people. According to the Genetics and Rare Diseases Information Center (GARD), "…there are more than 6,800 rare diseases. Altogether, rare diseases affect an estimated 25 million to 30 million Americans." Rare genetic diseases are typically transmitted from parents to offspring and involve mutations in a single gene; this makes them excellent targets for studies in model organisms.



Among the menagerie of model organisms studied by NHGRI-funded researchers is the zebrafish. The zebrafish has been used as an experimental model organism since the 1960s because of its small size, fast growth rate, and relatively inexpensive care requirements. As part of the Institute's Intramural Research Program, NHGRI is 'half owner' of one of the largest zebrafish research facilities in the world [with the other owner being The *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD)]. Within this facility, NHGRI has developed the expertise to perform cutting-edge manipulations of the zebrafish genome, for example using the powerful CRISPR-Cas9 genome-engineering system. For any gene implicated in a human disease, NHGRI researchers can readily alter the corresponding gene in the zebrafish genome and then assess if the resulting mutant zebrafish has the same phenotypic features as the human disease.

Webinars for Health Insurers and Payers: Understanding Genetic Testing

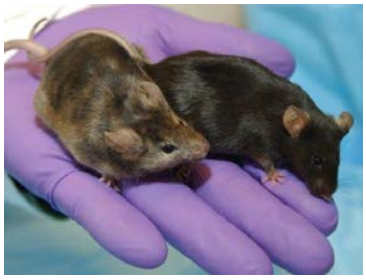
NHGRI's Inter-Society Coordinating Committee for Provider Education (ISCC) collaborated with the Blue Cross Blue Shield Association to produce an educational webinar series titled "Webinars for Health Insurers and Payers: Understanding Genetic Testing," that aims to address the growing need for medical staff in the insurance industry to understand genetic testing. The goal of the series is to educate insurers about genetic testing (strategies, interpretations, outcomes, etc.) and to use that understanding to aid their decisions regarding the healthcare activities of their insured. Starting in June 2015, thirteen monthly live webinars were produced by volunteer experts in genetic testing and genomic medicine. Each session was recorded and is now available at genome.gov/27563343/.

NHGRI Commits to Expanded Training Program in Genomic Medicine

Along with the plethora of genetic and genomic information that comes from the use of newer genomic technologies and the lower costs associated with sequencing the human genome, many challenges exist to translating the genome's power into medicine. To meet some of those challenges, NHGRI has funded three new training programs to train genomic medicine researchers and to provide enhanced training in

As one illustrative example, Dan Kastner (NHGRI Scientific Director) and Shawn Burgess (Head of the NHGRI Developmental Genomics Section) used zebrafish to study a gene thought to be involved in strokes and vascular inflammation in children. Following the introduction of targeted mutations in the suspected gene, the resulting zebrafish mutants were found to exhibit stroke symptoms, yielding strong confirmation of the role of a suspected gene in the human disease.

Model organisms are now playing a major role in the NIH Common Fund's Undiagnosed Diseases Network (UDN). To augment their studies of patients with undiagnosed conditions, the UDN recently started a Model Organisms Screening Center that will use both zebrafish and fruit flies as models to study gene variants that are thought to be involved in unknown diseases in UDN patients. The NIH Undiagnosed Diseases Program (UDP), a predecessor and part of the current UDN, also collaborates with the previously mentioned zebrafish facility within the NHGRI Intramural Research Program.

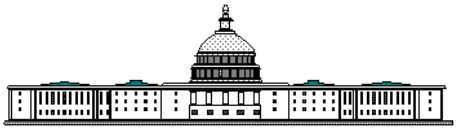


Another NIH Common Fund program, the Knockout Mouse Phenotyping Program (KOMP^2), a follow-on to the Knockout Mouse Project (KOMP), is an effort to create and characterize a collection of mice containing a null mutation — a mutation that results in a complete functional loss of a particular gene — in every gene in the mouse genome. The value of the mouse as a model organism comes from the fact that mice have similar developmental, physiological, biochemical, and behavioral features as humans. Therefore, advances in mouse genetics continue to be a driving force for a broad range of biomedical research activities, including the study of rare disease.

In summary, model organism research continues to play a central role in the study of human biology and disease. The above examples only represent a subset of the ways in which NHGRI programs capitalize on the powerful insights that model organisms provide about genome function. Meanwhile, it is fully anticipated that continued technological advances will increase the use of these 'critters' for helping us understand the complexities of human disease.

genomics for clinicians. NHGRI is building on its 20+ year investment in genomic science training grants by broadening our training portfolio to incorporate genomic medicine, a critical research area. The new programs will teach practical skills for applying computational tools for disease-gene discovery, patient genome interpretation, and big data management in genomic medicine research. For more information, see genome.gov/27565602.

NHGRI Genome Statute and Legislation Database



NHGRI maintains a Genome Statute and Legislation Database, comprised of summaries of state statutes and bills introduced during the 2007-2016 U.S. state legislative sessions. Searchable topics in the database include employment and insurance nondiscrimination, health insurance coverage, privacy, research, and the use of residual newborn screening specimens. For example, the database contains information about 104 statutes related to health insurance non-discrimination, 108 statutes related to privacy, and 91 statutes related to employment non-discrimination. A text search option is also provided for searches on additional topics. For more information, see genome.gov/PolicyEthics/LegDatabase/pubsearch.cfm.

Spotlight on the Precision Medicine Initiative (PMI)
nih.gov/precisionmedicine

- The PMI has issued a vacancy announcement for the PMI Cohort Program Deputy Director position.

Funding Opportunities

Small Research Grants for Analyses of Data for the Gabriella Miller Kids First Data Resource

Genomics Research

A Federated Ecosystem for Sharing Genomic, Clinical Data

Precision Medicine: Using Genomic Data to Predict Drug Side Effects and Benefits

Probing Proteins' 3-D Structures Suggests Existing Drugs May Work for Many Cancers

Supercomputer Changing Genetic Medicine in Africa

Human Brain Houses Diverse Populations of Neurons, New Research Shows

How Will Genomics Enter Day-to-Day Medicine?

Funding News

NIH Research Involving Chimpanzees

Form Correction Made for All NIH Fellowship Opportunities

Final NIH Policy on the Use of a Single Institutional Review Board for Multi-Site Research

Scenarios to Illustrate the Use of Direct and Indirect Costs for Single IRB Review

New Videos

The Genomic Landscape of Breast Cancer in Women of African Ancestry – Olufunmilayo I. Olopade

Investigational Device Exemptions (IDE) and Genomics Workshop

Advisory Committee to the NIH Director Meeting – Day 1 and Day 2

NIH/NHGRI News of Interest

Appointment of Dr. Karen L. Parker as Director of the Sexual & Gender Minority Research Office, NIH

Statement on the National Academy of Sciences Report on Gene Drives in Non-Human Organisms

New NIH Studies Seek Adults and Families Affected by Sickle Cell Disease/Trait

Unlocking Life's Code: June 2016 Newsletter – What Controls Variation In Human Skin Color?

Single IRB Policy to Streamline Reviews of Multi-Site Research

Significant Expansion of Data Available in the Genomic Data Commons