Advancing Disease Modeling in Animal-Based Research in Support of Precision Medicine
October 5-6, 2017

The Evolution and Foundations of Precision Medicine

India Hook-Barnard, PhD
Director of Research Strategy
Associate Director, Precision Medicine
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Executive Director, CIAPM
What is Precision Medicine?

How did we get here?
What is Precision Medicine?

“Precision medicine is an emerging approach for disease prevention and treatment that takes into account people’s individual variations in genes, environment, and lifestyle.”

--National Institutes of Health
The Human Genome Project

NAS 1988

March 30, 1988, President Carter announces the Human Genome Project

June 26, 2000

Feb 2001
The Human Genome Project

“The First Law of Technology says we invariably overestimate the short-term impact of a truly transformational discovery, while underestimating its longer-term effects.”
"The cost of sequencing the first human genome was about $400 million. Today, the cost of sequencing one genome stands at $9,500, and, within the next four or five years, we expect to reach the point where we can sequence an individual's genome for $1,000 or less. This impressive decline in cost has fueled a rapid expansion in the medical applications of DNA sequencing and related technologies.”

Francis Collins, June 25, 2010, Scientific American
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A Framework for a New Taxonomy of Disease

THE NATIONAL ACADEMIES
NATIONAL ACADEMY OF SCIENCES
INSTITUTE OF MEDICINE
NATIONAL ACADEMY OF ENGINEERING
NATIONAL RESEARCH COUNCIL
DIVISION ON EARTH AND LIFE STUDIES
BOARD ON LIFE SCIENCES

PROJECT DESCRIPTION
Framework for Developing a New Taxonomy of Disease

Statement of Task

At the request of the Director’s Office of NIH, an ad hoc committee of the National Research Council will explore the feasibility and need, and develop a potential framework, for creating a “new taxonomy” of human diseases based on molecular biology. As part of its deliberations, the committee will host a large two-day workshop that convenes diverse experts in both basic and clinical disease biology to address the feasibility, need, scope, impact, and consequences of defining this new taxonomy. The workshop participants will also consider the essential elements of the framework by addressing topics that include, but are not limited to:

• Compiling the huge diversity of extant data from molecular studies of
A Framework for a New Taxonomy of Disease

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Project Context and Issues
Remarkable advances in molecular biology have brought biomedical research to an “inflection point,” putting the life sciences at the cusp of delivering dramatic improvements in understanding disease to reap the health benefits that formed the rationale for the Human Genome Project.
Committee on A Framework for Developing a New Taxonomy of Disease

SUSAN DESMOND-HELLMANN, (CO-CHAIR), University of California, San Francisco
CHARLES SAWYERS, (CO-CHAIR), Memorial Sloan-Kettering Cancer Center
DAVID R. COX, AQG, Pfizer Inc.
CLAIRE FRASER-LIGGETT, University of Maryland, School of Medicine
STEPHEN J. GALLI, Stanford University
DAVID B. GOLDSTEIN, Duke University School of Medicine
DAVID J. HUNTER, the Harvard School of Public Health
ISAAC S. KOHANE, Harvard Medical School
MANUEL LLINAS, Princeton University
BERNARD LO, University of California, San Francisco
TOM MISTELI, National Cancer Institute
SEAN J. MORRISON, University of Michigan
DAVID G. NICHOLS, the Johns Hopkins University School of Medicine
MAYNARD V. OLSON, University of Washington
CHARMAINE D. ROYAL, Duke University
KEITH R. YAMAMOTO, University of California, San Francisco
"The Committee is of the opinion that realizing the full promise of precision medicine, whose goal is to provide the best available care for each individual, requires that researchers and health-care providers have access to very large sets of health and disease-related data linked to individual patients."
Building a Knowledge Network

GIS layers organized by geographic positioning

- Transportation
- Land Use
- Census Tracts
- Structures
- Postal Codes
- Raster Imagery

Information Commons organized around individual patient

- Genomics
- Microbiome
- Exposures
- Behaviors
- Clinical tests
- Phenotypic data

Google Maps

Knowledge Network
Building a Knowledge Network

- Genetic code - Molecular Mechanisms
- Billing code - EHR, Biospecimens, Clinical Outcomes
- Zipcode - Environmental, Social Determinants

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1. Enable Discovery  2. Improve Clinical Care  3. Inform Public Health

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Building a Knowledge Network
Toward Precision Medicine
Thank you

Art: Nicolle Ranger Fuller, Sayo-Art LLC
Beyond Signs & Symptoms
A "Map View" of Medicine

Toward Precise Medicine
Understanding Illness & Health
Beyond Symptoms
Illness as Messenger
From Sickness to Health
Toward Personalized Medicine

Integrating & Leveraging Biomedical Research: A Framework for New Taxonomy of Disease
Unifying Medicine and Data-Intensive Biology