NIAID Genomics and Bioinformatics Program

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NIH’s Mission:
Science in Pursuit of Knowledge to Improve Health

Slide Source: A. S. Fauci
NIH: Role in Medicine

- Uncover new knowledge that leads to better health for everyone by:
  - Conducting research in its own laboratories
  - Supporting research of non-Federal scientists in universities, medical schools, hospitals, and research institutions throughout United States and overseas
  - Helping train research investigators
  - Fostering communication of medical information

Slide Source: A. S. Fauci
NIH Consists of 27 Institutes and Centers

= Extramural only

3/2013
Slide Source: A. S. Fauci
The National Institute of Allergy and Infectious Diseases (NIAID)

- Conducts and supports basic and applied research to better understand, treat, and ultimately prevent infectious, immunologic, and allergic diseases.

http://www.niaid.nih.gov/
NIAID Research: A Dual Mandate

Maintain and “grow” a robust basic and applied research portfolio in microbiology, infectious diseases, immunology and immune-mediated diseases

Respond rapidly to new and emerging disease threats

New/Improved Interventions

Slide Source: A. S. Fauci
The Research Path

Global and Domestic Research

Basic Research

Genomics

Vector Biology

Clinical Trials

Vaccines and Other Prevention Tools

Therapeutics

Diagnostics

Improved Global Health

Slide Source: A. S. Fauci
Global Examples of Emerging and Re-Emerging Infectious Diseases

To provide comprehensive genomics, function genomics, proteomics, structural genomics, bioinformatics and other ‘omics’ resources to the scientific community for basic and applied research in infectious diseases to understand pathogen-host interactions and develop targets for drugs, vaccines and diagnostics.
OMICS/Systems Biology Approach to Infectious Diseases

Cell Lines, Animal Models, Tissues, Clinical Samples,

Genomics Transcriptomics
Metagenomics/Metaomics
Functional Genomics/Proteomics
Metabolomics
Glycomics Lipidomics

MICROBE HOST MICROBIOME

Systems Biology Bioinformatics

Understanding Microbe/Pathogen-Host, Disease, Drug Resistance
Build Networks/Pathways

Biomarkers Targets Diagnostics Therapeutics Vaccines
Knowledge from Data

Challenge
Rapidly expanding volume, complexity, and range of data

Exploit data to understand, prevent, diagnosis and treat infectious diseases
To address key questions in microbiology and infectious disease

To identify new targets and develop new strategies for vaccines, diagnostics and therapeutics
2014: >16,500 influenza viral genomes sequenced at JCVI
2004: 80 influenza genomes in GenBank
2009: 2057 H1N1 pandemic strains; 75% H1N1 genomes in GenBank
75% Complete influenza genomes in GenBank by JCVI

New Directions - Data Integration

Comparative Genomics   Metabolic Network Analysis   Regulatory Networks

Insights into Pathogenesis + New Targets for Intervention

J. Galagan, Broad MSC
Goal: To use computational and experimental approaches to identify, model and predict the pathways and networks derived from pathogen/host interactions

Key Features:
- Combination of multiple omics technologies
- Genetic and biochemical networks of pathogenesis
- Data integration and computational / predictive modeling
- Public release of data and other resources
- Malaria, Influenza, Tuberculosis
- Ebola and West Nile Viruses

http://www.niaid.nih.gov/LabsAndResources/resources/dmid/sb/Pages/default.aspx
Building Bioinformatics Capacity for Infectious Diseases Community

- Provide integrated bioinformatics resources in support of basic and applied infectious diseases research

  Data management, data sets, data sharing guidelines, data analysis, computational and informatic tools, data standards, workspaces, web interfaces, and training
BIG DATA

NIH Big Data to Knowledge Initiative for Research Data

BD2K
1. Locating the data
2. Getting access to the data
3. Extending policies and practices for data sharing
4. Organizing, managing, and processing biomedical Big Data
5. Developing new methods for analyzing biomedical Big Data
6. Training researchers who can use biomedical Big Data effectively
Data Types across NIH Interests

Genomic

Imaging

Exposure

Other ‘omic

Phenotypic

Clinical

Courtesy of NHGRI
Big Data to Knowledge (BD2K): Overview

- Major trans-NIH initiative addressing an NIH imperative and key roadblock in data management, communication, and interpretation
- Aims to be catalytic and synergistic
  - Develop and enhance data standards, data access, tools, software, and policies for data and software sharing, etc to effectively use Big Data
- NIH Common Fund and IC Funding
- Overarching goal
  *By the end of this decade, enable a quantum leap in the ability of the biomedical research enterprise to maximize the value of the growing volume and complexity of biomedical data*
BD2K: Four Programmatic Areas

I. Facilitating Broad Use of Biomedical Big Data

II. Developing and Disseminating Analysis Methods and Software for Biomedical Big Data

III. Enhancing Training for Biomedical Big Data

IV. Establishing Centers of Excellence for Biomedical Big Data

Slide Eric Green, NHGRI