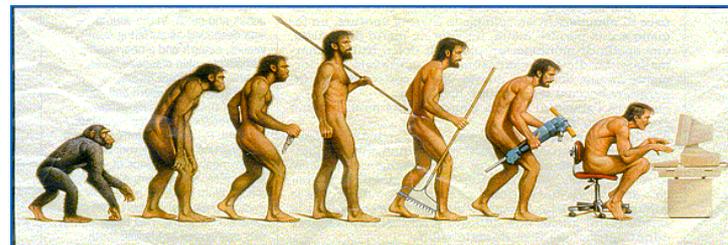




Joint Federal Agency Diet and Omics Workshop

Beltsville, MD

31 March 2009



Bioinformatic Needs for Individual Nutrient and Activity Assessments

Jim Kaput PhD

Director – Division of Personalized Nutrition and Medicine

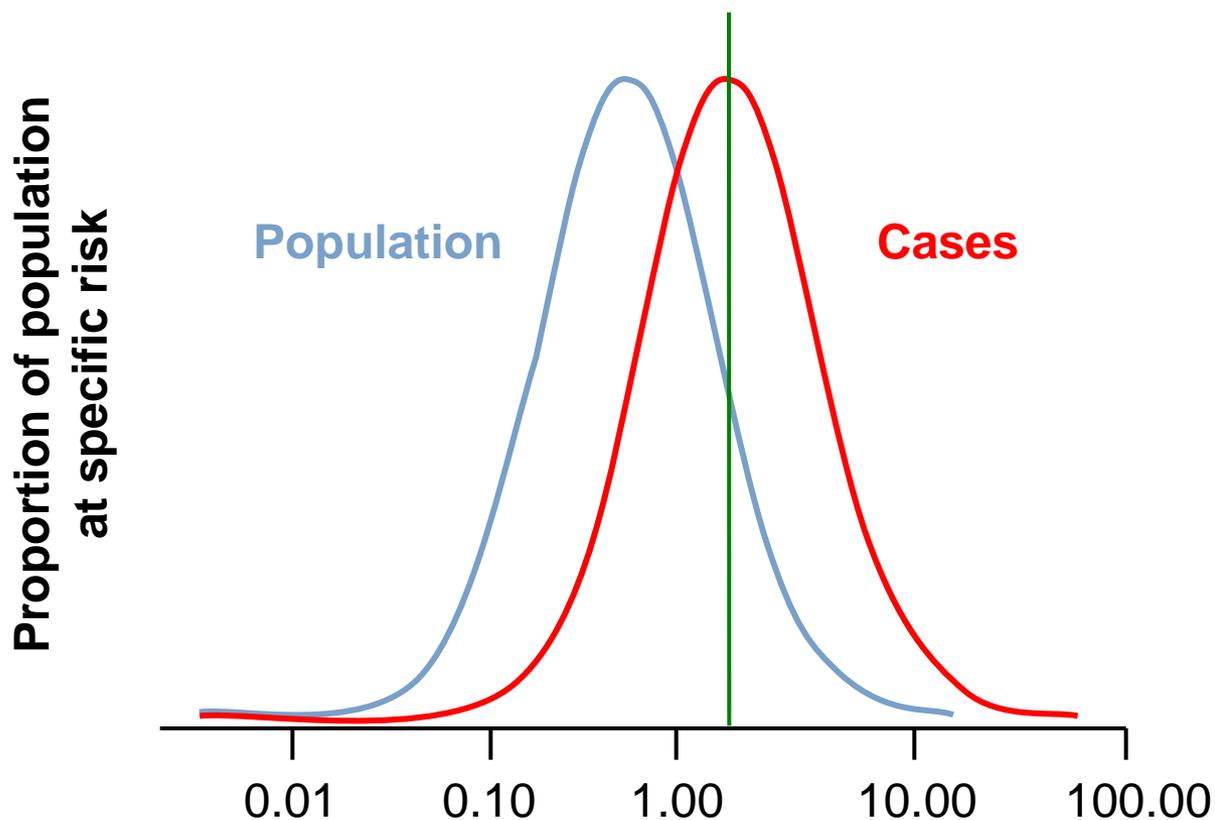


FDA/National Center for Toxicological Research

Jefferson, Arkansas 72201

James.Kaput@fda.hhs.gov

The Questions for Personalizing Healthcare



Why is there a distribution of health within a population ?

Why is there a distribution within cases (disease)?

Is risk as calculated for population useful for the individual??

What path to knowledge??

Basis of Nutrigenomics

A different effect of a *genotype* on disease in persons with different *environmental* exposures



Genotype X Environment Interactions

A different effect of an *environmental* exposure on disease risk in persons with different *genotypes*

Ottman, *Prev. Med* 25, 764 (1996)

Statistical
Parlance

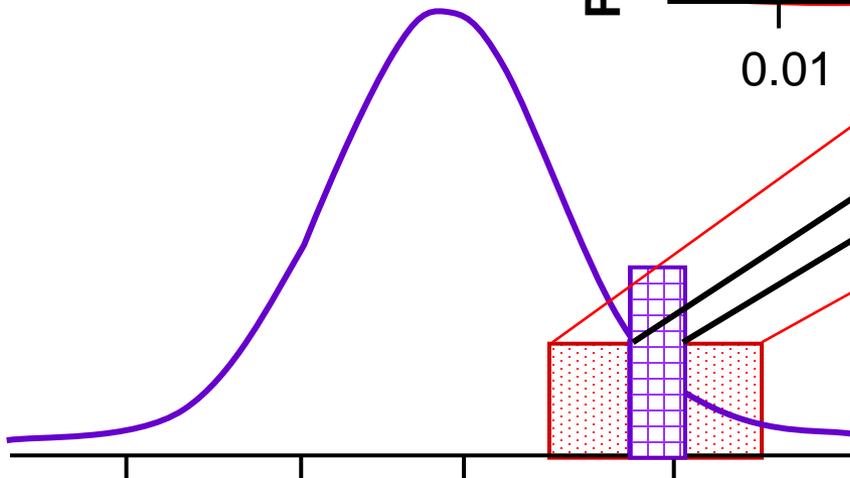
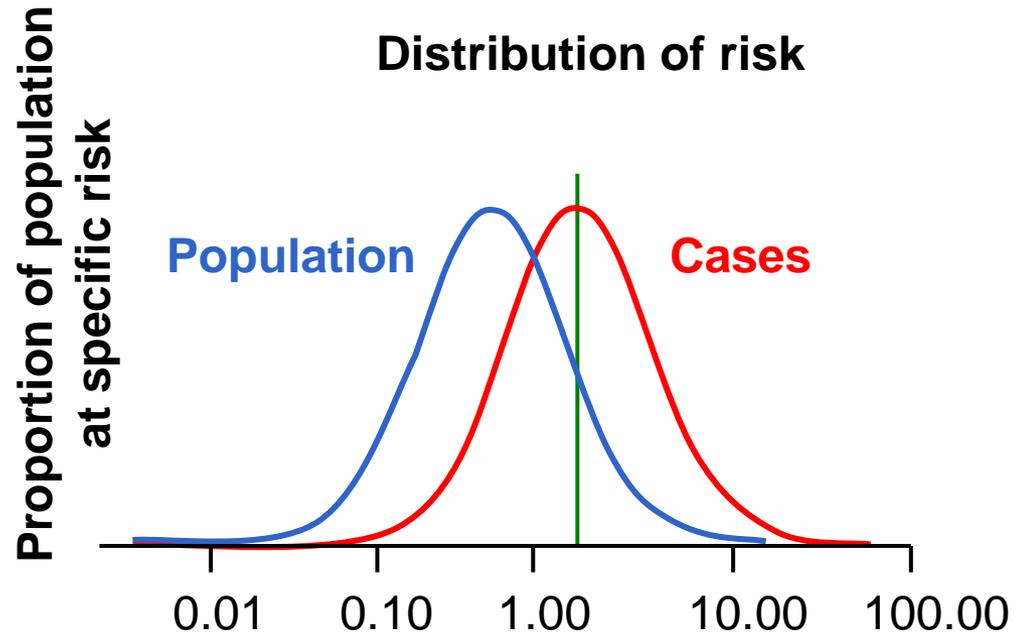
The *main effect(s)* may be *genotype x environment interaction(s)* for chronic diseases and modifying effects

The Logic

Insanity

Doing the same things
over and over and
expecting
different results

Albert Einstein

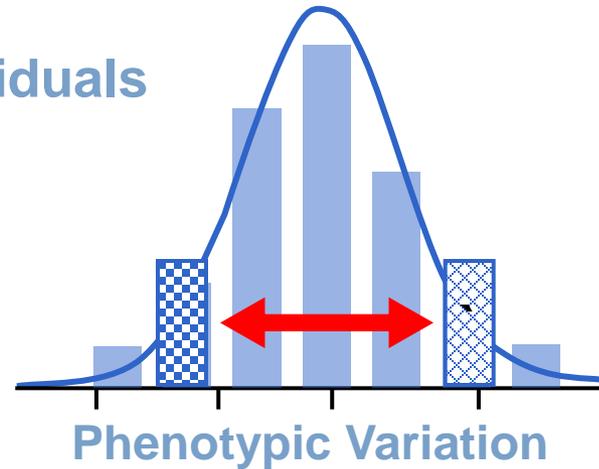


Limited variations
may reduce effect size

Human genetic, nutritional, physiological variations

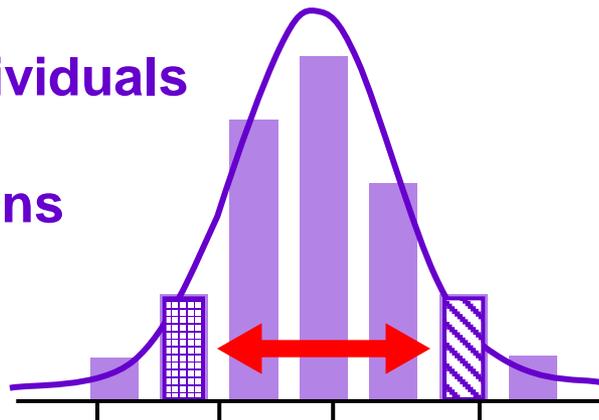
The Process

(1a) Pre-select and bin individuals of different phenotypes
(With dietary assessments)



or

(1b) Pre-select and bin individuals of different genotype x environment interactions



Genetic x Environment Interactions

2a) Compare

Genotype x Environment Interactions

3a) Fill in bins

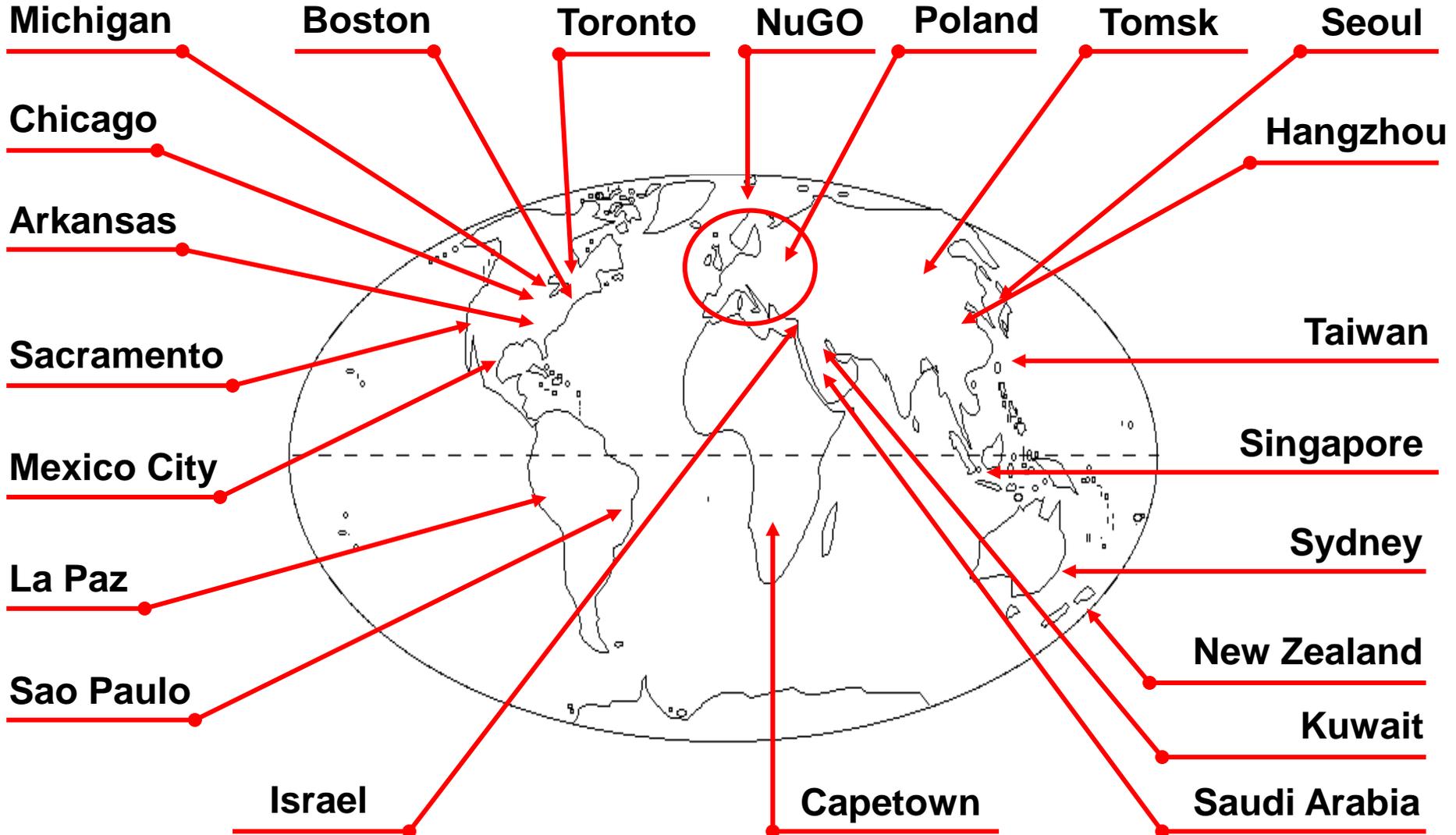
2a) Compare

Genotype x Environment Interactions

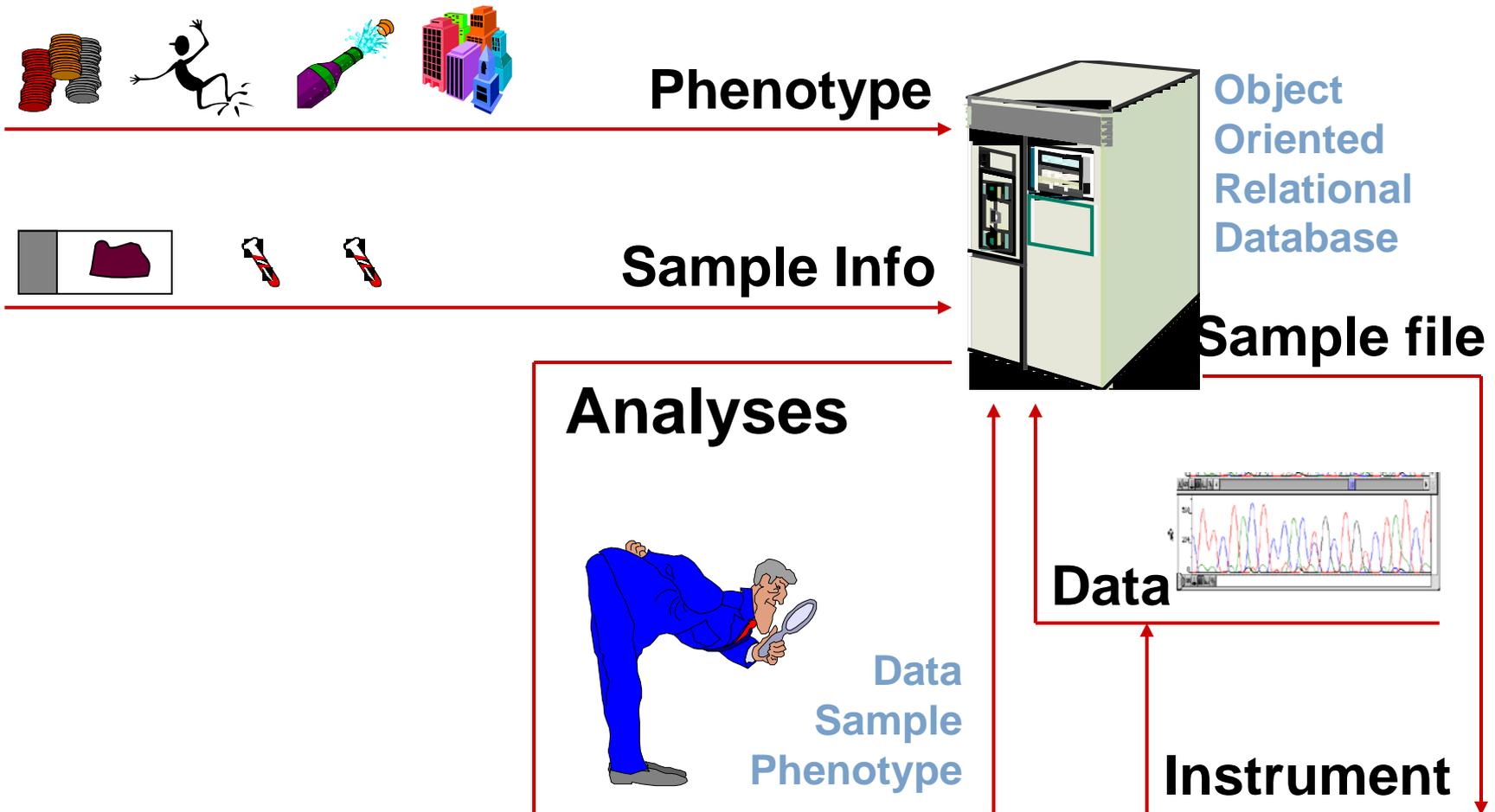
3b) Fill in bins



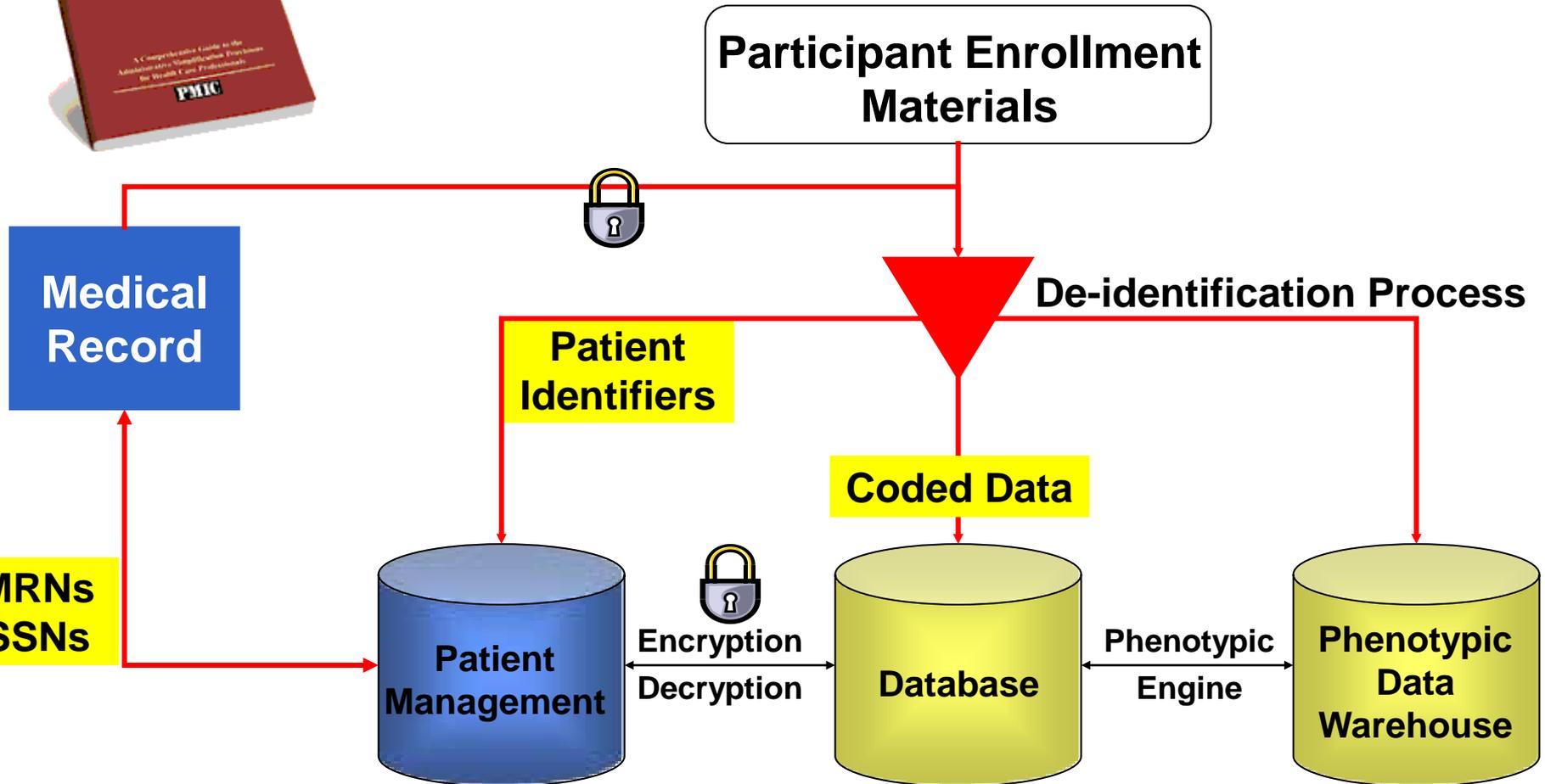
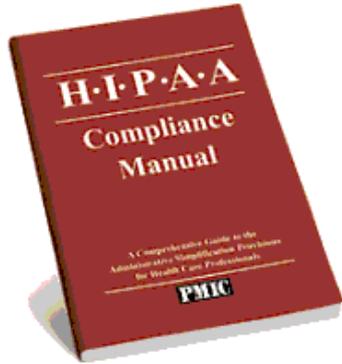
T2DM Nutrigenomics Network: Populations



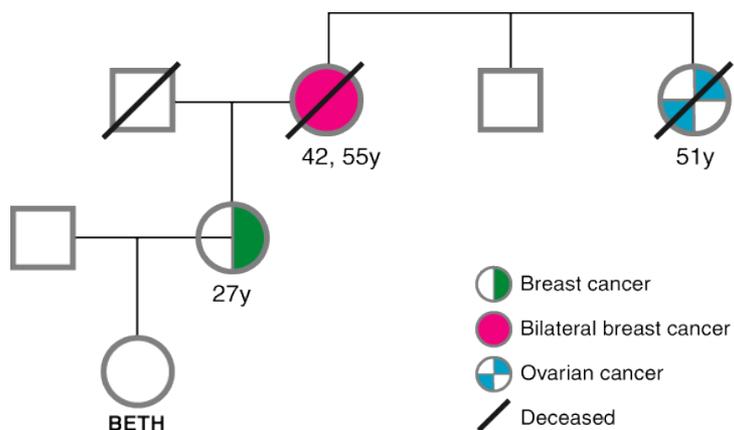
Data Capture & Analyses



Information System Schematic



Electronic Repository



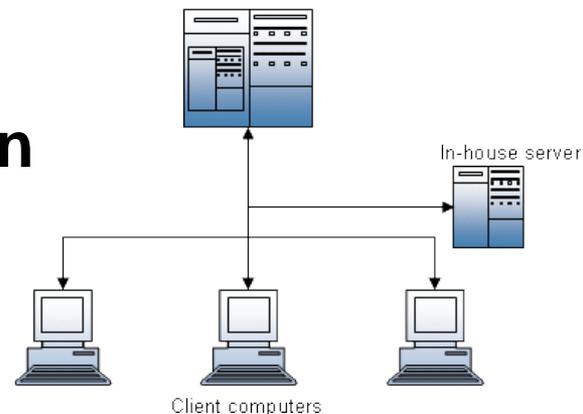
Clinical data/automated mining

Epidemiological data

Genotype/haplotype/sequence

Diet and nutrition

Other lifestyle



Welcome to the Entrez cross-database search page

 PubMed: biomedical literature citations and abstracts	 Books: online books
 PubMed Central: free, full text journal articles	 OMIM: online Mendelian Inheritance in Man
 Site Search: NCBI web and FTP sites	 OMIA: online Mendelian Inheritance in Animals

 Nucleotide: Core subset of nucleotide sequence records	 dbGaP: genotype and phenotype
 EST: Expressed Sequence Tag records	 UniGene: gene-oriented clusters of transcript sequences
 GSS: Genome Survey Sequence records	 CDD: conserved protein domain database
 Protein: sequence database	 3D Domains: domains from Entrez Structure
 Genome: whole genome sequences	 UniSTS: markers and mapping data
 Structure: three-dimensional macromolecular structures	 PopSet: population study data sets
 Taxonomy: organisms in GenBank	 GEO Profiles: expression and molecular abundance profiles
 SNP: single nucleotide polymorphism	 GEO DataSets: experimental sets of GEO data
 Gene: gene-centered information	 Cancer Chromosomes: cytogenetic databases
 HomoloGene: eukaryotic homology groups	 PubChem BioAssay: bioactivity screens of chemical substances
 GENSAT: gene expression atlas of mouse central nervous system	 PubChem Compound: unique small molecule chemical structures
 Probe: sequence-specific reagents	 PubChem Substance: deposited chemical substance records
 Genome Project: genome project information	 Protein Clusters: a collection of related protein sequences

 Journals: detailed information about the journals indexed in PubMed and other Entrez databases	 MeSH: detailed information about NLM's controlled vocabulary
 NLM Catalog: catalog of books, journals, and audiovisuals in the NLM collections	

In this section

- ▶ Research areas & faculty
- ▶ Working with us
- ▶ Collaborative research programs
- ▶ Why mouse genetics?
- ▶ **Genetic resources & information**
 - Databases & information
 - Software & analysis tools
 - Other mouse resources

Related topics

Repository information

Additional repository resources have been created to facilitate the use of JAX® Mice.
▶ [Learn more](#)



Home > Research and resource initiatives > Genetic resources & information

Genetic resources & information

The Jackson Laboratory is the world's leading resource for mouse genetic data, colony management, research techniques and scientific services.

Databases & information

- ▶ Mouse Phenome Database
- ▶ Mouse Genome Informatics
- ▶ Joan Staats Library
- ▶ Hereditary Hearing Impairment in Mice
- ▶ Inbred Strain Characteristics
- ▶ Eye Mutant Resource
- ▶ Nomenclature Guidelines
- ▶ Genotyping Tools
- ▶ Mouse Data Charts

Software & analysis tools

- ▶ JAX Colony Management System
- ▶ Gene Expression Analysis

Other mouse resources

- ▶ Federation of International Mouse Resources (FIMRE)
- ▶ International Mouse Strain Resources (IMSR)
- ▶ Knockout Mouse Project (KOMP)
- ▶ Mutant Mouse Regional Resource Centers (MMRRC)

Shortcuts for researchers

- ▶ Mouse Genome Informatics (MGI)
- ▶ Search for JAX® Mice
- ▶ Mouse Phenome Database

More resources

Related links

At the Jackson Laboratory

- ▶ [Donate a strain](#)
- ▶ [Technology transfer office](#)
- ▶ [Cryopreservation Laboratory](#)

On the web

- ▶ [Isogenic.info](#)

Mouse Databases and Tools

<http://research.jax.org/resources/index.html>

WIKI FEATURES AND COMMENTING

Towards a cyberinfrastructure for the biological sciences: progress, visions and challenges

Lincoln D. Stein

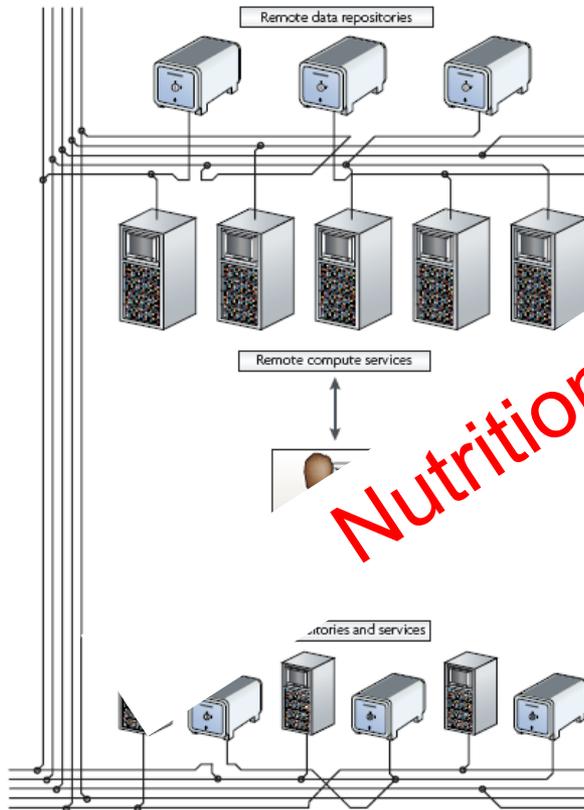
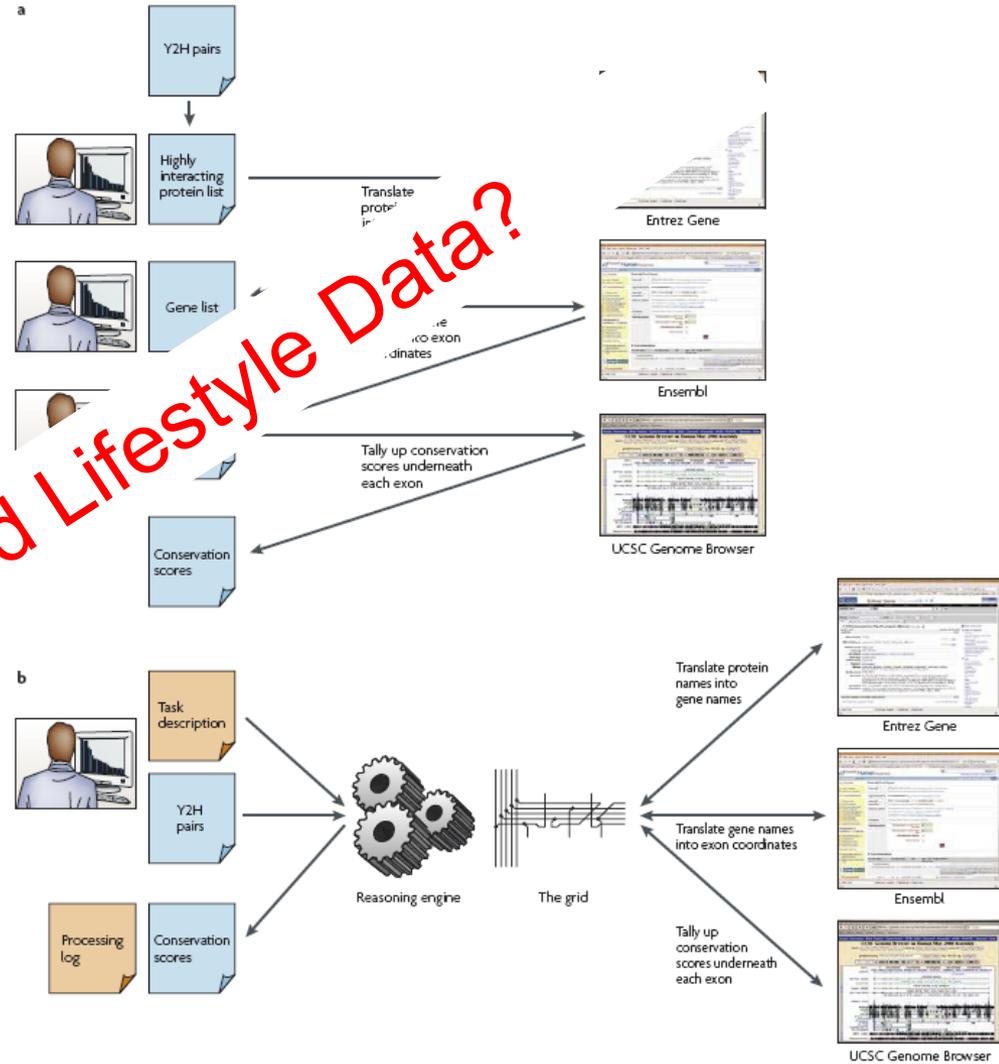


Figure 1 | The components of a cyberinfrastructure. A cyberinfrastructure consists of data repositories for storing community data sets and compute services for querying, integrating and analysing that data. Local data sets and compute services can be plugged into the cyberinfrastructure to allow individual researchers and groups of collaborators to work with private and semi-private data sets in the context of the community resources.

Nutritional and Lifestyle Data?





NUTRIENT DATA LABORATORY

Search the USDA National Nutrient Database for Standard Reference

This interface allows simple searches. Enter up to 5 keywords which best describe your food item. Select a Food Group. Then click on the Submit button. If you don't get a match, check your spelling or try a related keyword. If you get too many food items, try a more specific keyword. If you enter two or more keywords, the program will search for food items which contain all of the keywords. Keywords do not have to be adjacent or in the same order as they appear in the food item. You can exclude food items by placing the word "not" in front of a keyword.

For Example: Entering "apples not canned" will produce a list of food items containing the keyword "apples" but not the keyword "canned".

If you want to view reports on foods by single nutrients, such as calcium or niacin, view our [Nutrient Lists](#).

For more [information](#), including [documentation](#) and files for downloading, on SR20.

Keyword(s): [Help](#)

Select Food Group:

Home

How to get
information

Search FNIC

- Search all USDA
- Advanced Search
- Search Tips

Browse by Audience

Information for...

Browse by Subject

- ▶ Dietary Guidance
- ▶ Lifecycle Nutrition
- ▶ Diet and Disease
- ▶ Food Composition
- ▶ Weight and Obesity
- ▶ Food Safety
- ▶ Food Labeling
- ▶ Dietary Supplements
- ▶ Nutrition Assistance Programs
- ▶ Surveys, Reports and Research
- ▶ Professional and Career Resources

You are here: Home



The Food and Nutrition Information Center - a leader in food and human nutrition information dissemination since 1971. Provides credible, accurate, and practical resources for nutrition and health professionals, educators, government personnel and consumers. Learn more about FNIC's redesigned website.

Spotlights

More



FDA Public Hearing on Food Advisory Labeling
September 16, 2008.



State-Specific Prevalence of Obesity
Results from the 2007 BRFSS survey.



USDA Listening Sessions
Offer ideas for improving the Child Nutrition and WIC Programs.



Eat Smart. Play Hard.™ For Educators
Find educational materials and resources.



Healthy Meals Resource System (HMRS)
For Child Nutrition professionals.



Food Stamp Nutrition Connection (FSNC)
Resources for nutrition educators.



WIC Works Resource System (WWRs)
For maternal and child nutrition providers.



International Bibliographic Information on Dietary Supplements (IBIDS) Database



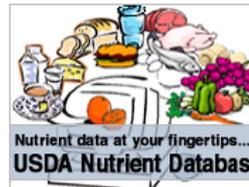
Food Safety Information Center
Information about foodborne illness prevention.



MyPyramid e-Catalog from SNE
Find reviewed MyPyramid education tools.

I Want To...

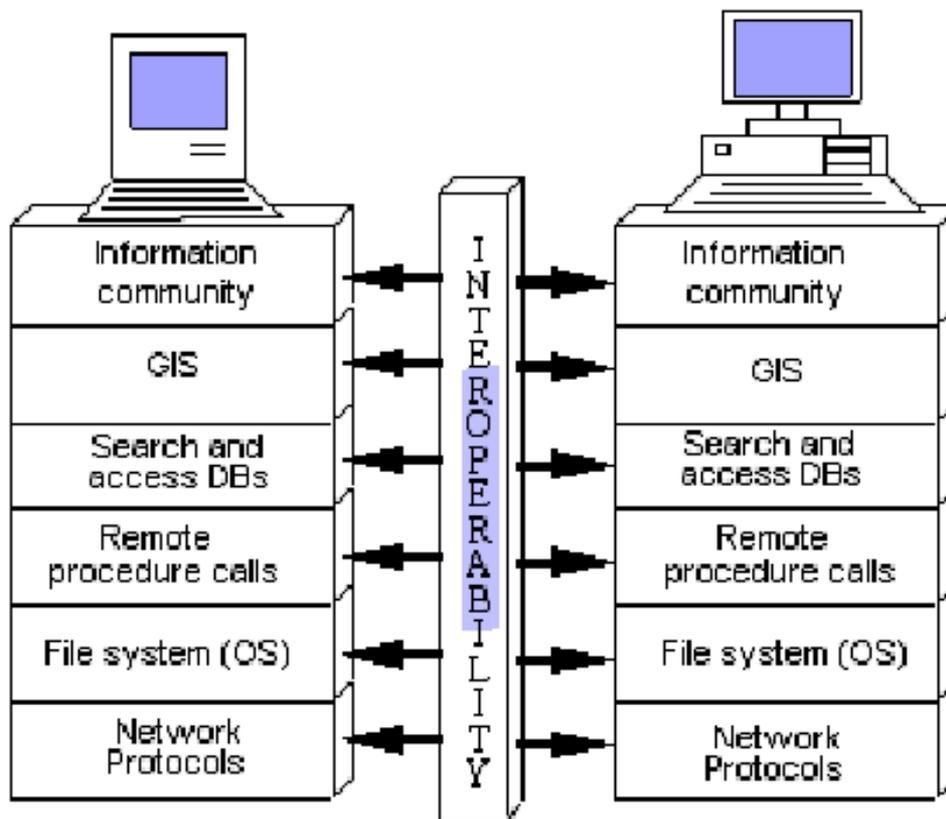
- See Topics A-Z
- Look up Calories or Nutrients in a Food
- See Dietary Guidelines for Americans
- Request Library Materials
- Ask a Question



See Also

- [Nutrition.gov](#)
- [Food and Nutrition Service](#)

Data & Semantic Interoperability



**National Biospecimen Network
caBIG – NCI Cancer Network**

<https://cabig.nci.nih.gov/>



Analyzing Complex Systems

The most basic issue of **organizational success** is *matching a system's complexity to its environment*

The complexity of the system performing that task must *match the complexity of the task*

Each person has a *limited level of complexity*

Distribute the complexity of the task among many individuals

Making things work: solving complex problems in a complex world
Yaneer Bar-Yam. Knowledge Press 2004

New England Complex Systems Institute (<http://necsi.org>)



Coordinating the Team

Analyze flow of information among teams

Create an environment where *evolution can take place*

Organizations that *learn by evolutionary change* create an *environment of innovation*

Evolution happens through competition and cooperation

Making things work: solving complex problems in a complex world
Yaneer Bar-Yam. Knowledge Press 2004

New England Complex Systems Institute (<http://necsi.org>)



Questions

What is needed to do better research bridging nutrition and the various omics?

Will omics improve nutrition/physical activity screening or replace them?

What is needed to allow scientists from multiple disciplines to improve their studies and more toward *personalized nutrition*?



Outcomes

Website to guide investigators on choosing appropriate tools for particular applications

If so, which tools?

Website (NLM or NAL) as a repository for study data

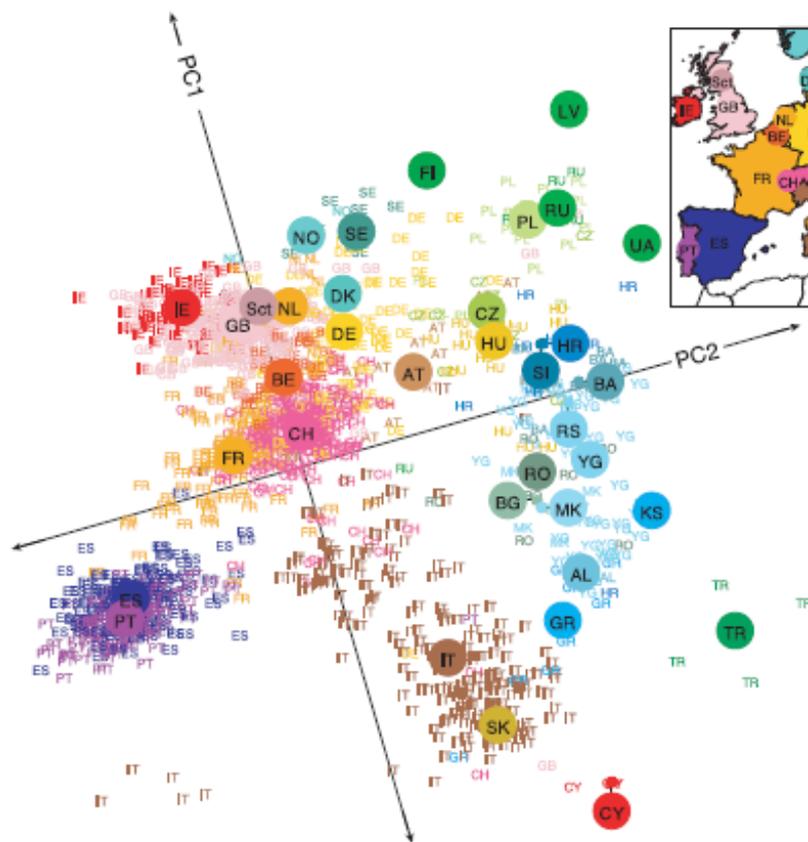
Publish proceedings of workshop?



U.S. Food and Drug Administration
Protecting and Promoting Public Health

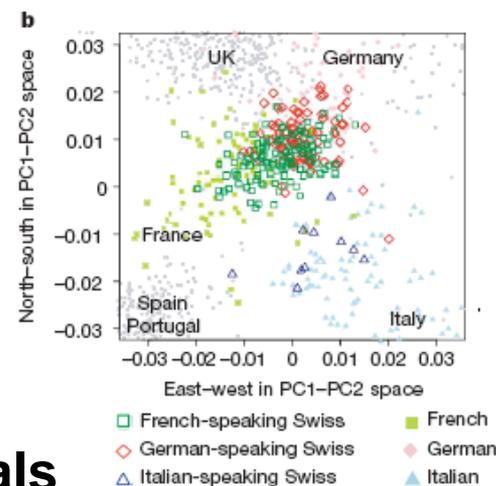
www.fda.gov
Division of Personalized Nutrition and Medicine

Geographical Genetics



197,146 loci
1,387 individuals

50% within ~200 miles of origin
90% within ~450 miles of origin





Genotype	Pheno	Pheno
A	6	9
B	2	2
C	8	3



Σ Phenotype / 16 =
Average Phenotype

A,B,C = variants of one gene or
A,B,C = variants of many genes

Σ Phenotype / 14 =
Average Phenotype



Unsupervised Analyses



Dimensionality reduction + classification algorithms



New: A1, B1, B2, C1, C2 = Genotype X Environment Interactions

Old: A, B, C = single genes or GWA, no environment (1,2)