
Dr. Data

Pediatrician Atul Butte:
Computing New Understandings of Disease

Findings

Department of Health and Human Services
National Institutes of Health
National Institute of General Medical Sciences

Butte Computes Disease

Pediatrician Butte studies genes to find new uses for existing medicines



Photo: Steve Gladfelter

Nosology

- Science of classifying diseases
- Categorizes diseases by symptoms and anatomy

Question:

Can different diseases have similarities?

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Answer: Yes

Diseases with different symptoms can have similarities

- Diseases with different symptoms may affect the same body system
- Diseases affecting different body systems can have the same symptoms
- Some different diseases are very similar at the level of genes

A Genomic Surprise

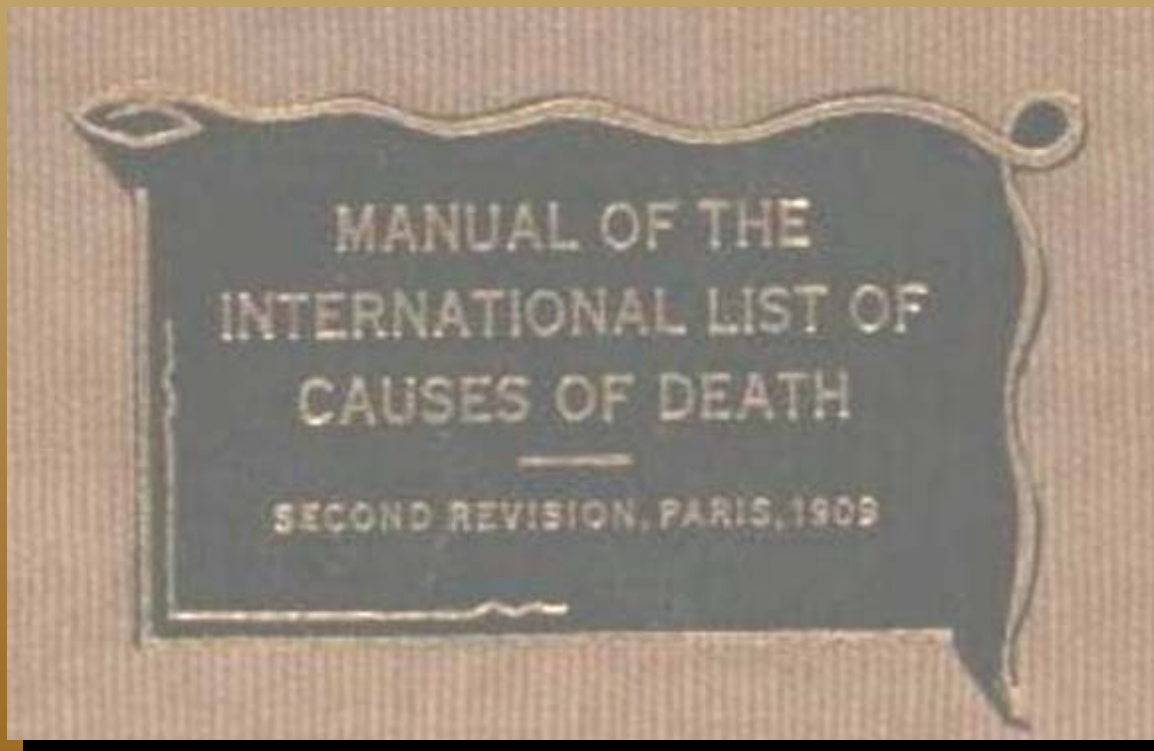
	Heart Attack	Muscular Dystrophy
Age group affected	Older people (usually)	Toddlers and youth
Lifestyle triggers	Yes (usually)	No
Prognosis	Usually treatable	Uncurable
Available medicines	>40	1

Butte's discovery: Heart attack and muscular dystrophy alter the activity of the same group of genes.

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Old Models of Classification

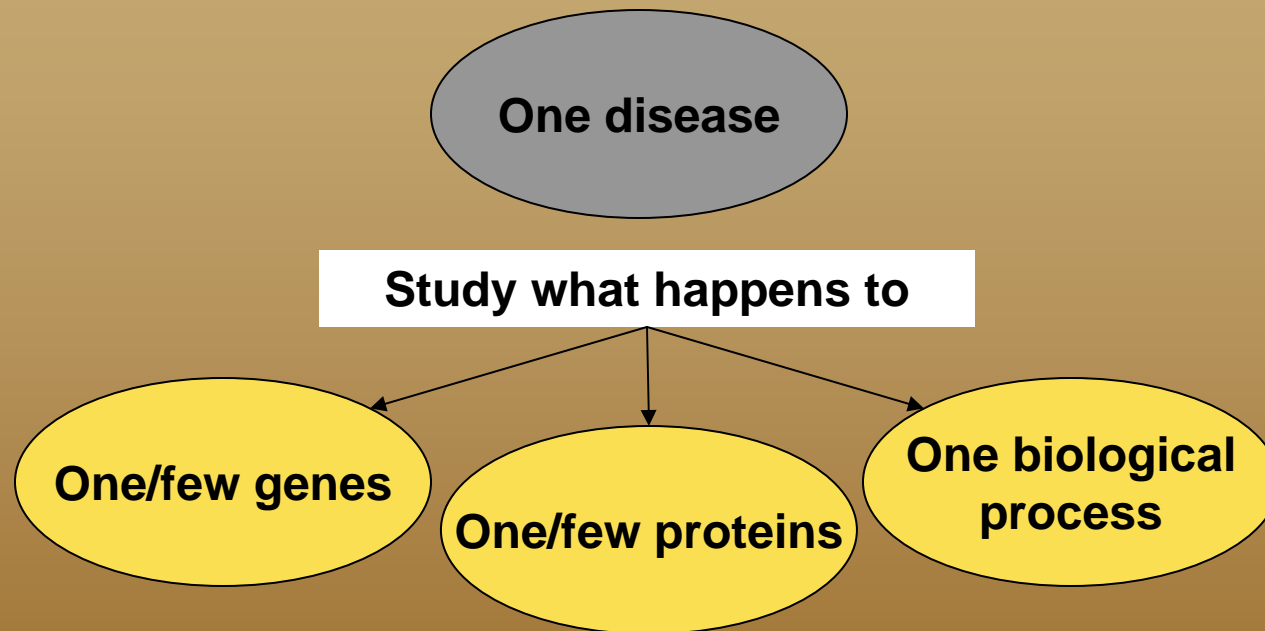


- Published in 1909
- Contains codes for common causes of death

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Traditional Model of Medical Research



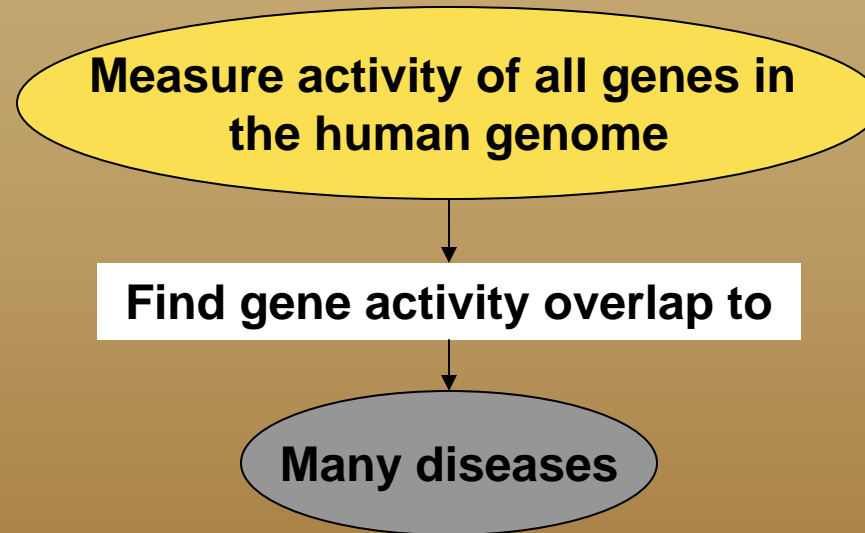
RESULT:

- 1. Understanding about how one disease affects the activity of one biological process**

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Butte's Approach



RESULT:

- 1. Understanding about the activity of genes across diseases**
- 2. Connections between different diseases at the genetic level**
- 3. Possibility of using existing medicines for one disease to treat another disease**

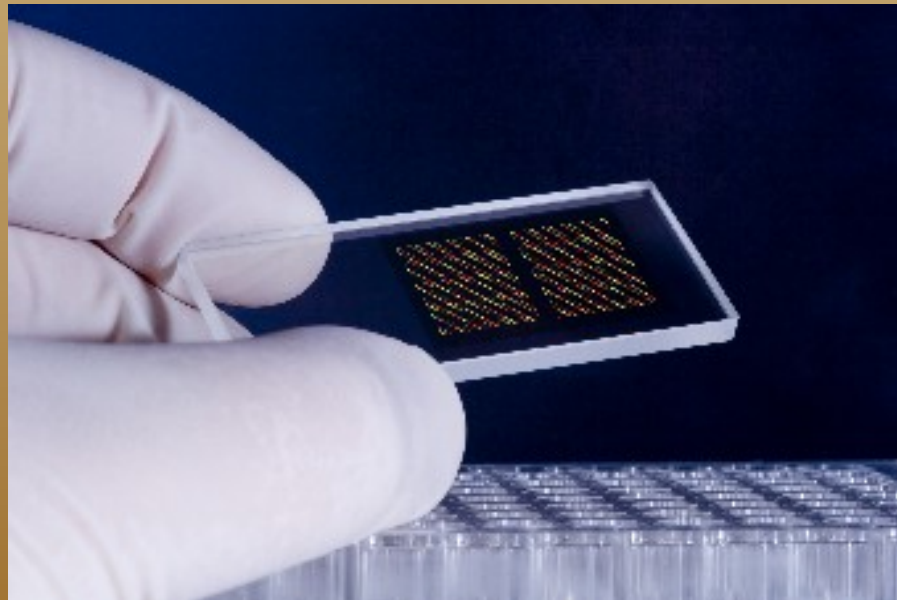
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Research Tools: Microarrays

Microarray

- Also called “DNA chip” and “gene chip”
- Thumbnail-sized
- Microscopic grid
- Contains pieces of DNA representing every gene in the genome



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The Power of GEO

The screenshot shows the NCBI Gene Expression Omnibus (GEO) website. The header includes the NCBI logo and the GEO logo with the text "Gene Expression Omnibus". Navigation links include HOME, SEARCH, SITE MAP, Handout, NAR 2006 Paper, NAR 2002 Paper, FAQ, MIAME, and Email GEO. The user is not logged in. A description of GEO is provided: "Gene Expression Omnibus: a gene expression/molecular abundance repository supporting MIAME compliant data submissions, and a curated, online resource for gene expression data browsing, query and retrieval." The main content area is divided into three sections: QUERY, BROWSE, and SUBMIT. The QUERY section has a search box with "cigarette smoke" entered and a "GO" button. The BROWSE section has a tree view for DataSets, GEO accessions, Platforms, Samples, and Series. The SUBMIT section has buttons for Direct deposit / update, Web deposit / update, and Create new account. A sidebar on the right shows "Public data" statistics: GPL Platforms 4135, GSM Samples 182963, GSE Series 7225, and Total 194323. Below this is "Site contents" with links for Documentation, Query & Browse, and Deposit & Update. At the bottom, there is a "Get GEO accession" search box and a "Depositors only" login section with fields for User, Password, and a LOGIN button.

Gene Expression Omnibus

- Database
- Repository for results of studies using microarrays
- 1,000 samples uploaded weekly
- Can be used for bioinformatics experiments

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Advances in Disease Research

- Multiple microarrays



How are these useful to scientists studying disease?

- The amount of life-science data



What challenges does this create?

- A genome-based disease classification system



How is this different from current disease classification systems?

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Research Applications

What are some implications of using existing medications to treat diseases other than those they initially were developed to treat?

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