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# Chain Reactions: Information Technology and Biomedical Discovery

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# Biomedical Informatics

The use of advanced IT to organize & understand biomedical data:

- DNA sequence (genome)
- Molecular (binding & catalysis)
- Cellular (gene expression)
- Organ (cellular communication)
- Organism (Electronic Medical Records)
- Populations (public health, social networks)

## Informatics exists because of IT explosion

- NIH Institutes support
- My course introduced 1994:  
“Representations & Algorithms for  
Molecular Biology”
- DOE leadership in human genome
- NSF role in biological database  
activities, supercomputer centers
- Industry (Microsoft, IBM, Oracle &  
others)

# Bioinformatics current challenges

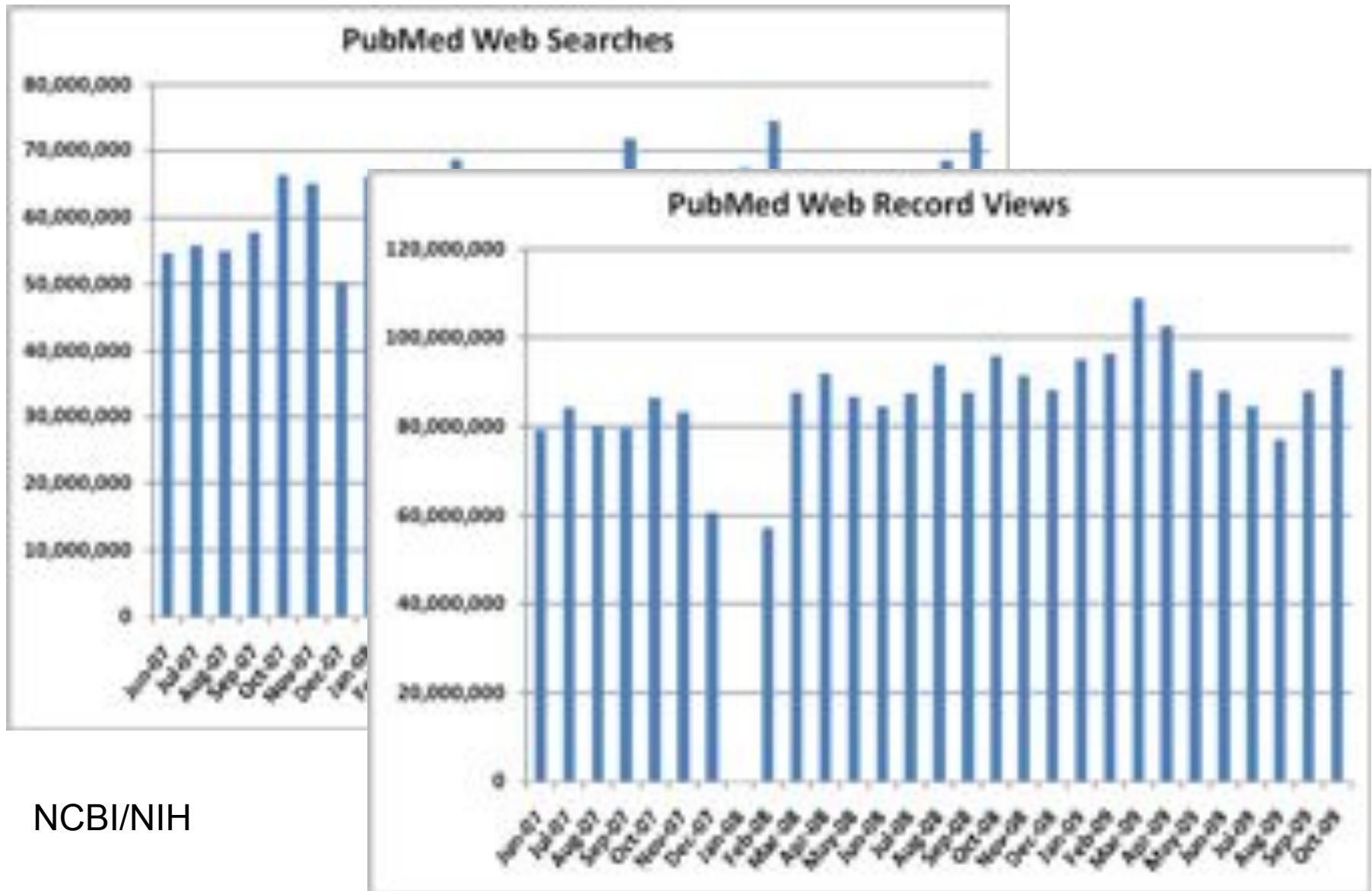


nas  
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# Key network & information technologies today

- Entire biomedical literature available for search every day ( $20 \times 10^6$  abstracts)
- Large stores of DNA data, 3D structure data, gene expression data freely available
- High precision physical simulation on clusters, GPUs to get to millisecond timescale
- Imaging data: increasing resolution and dynamic range
- Crowd sourced health data: from medical records to public health to search engines and social networks.

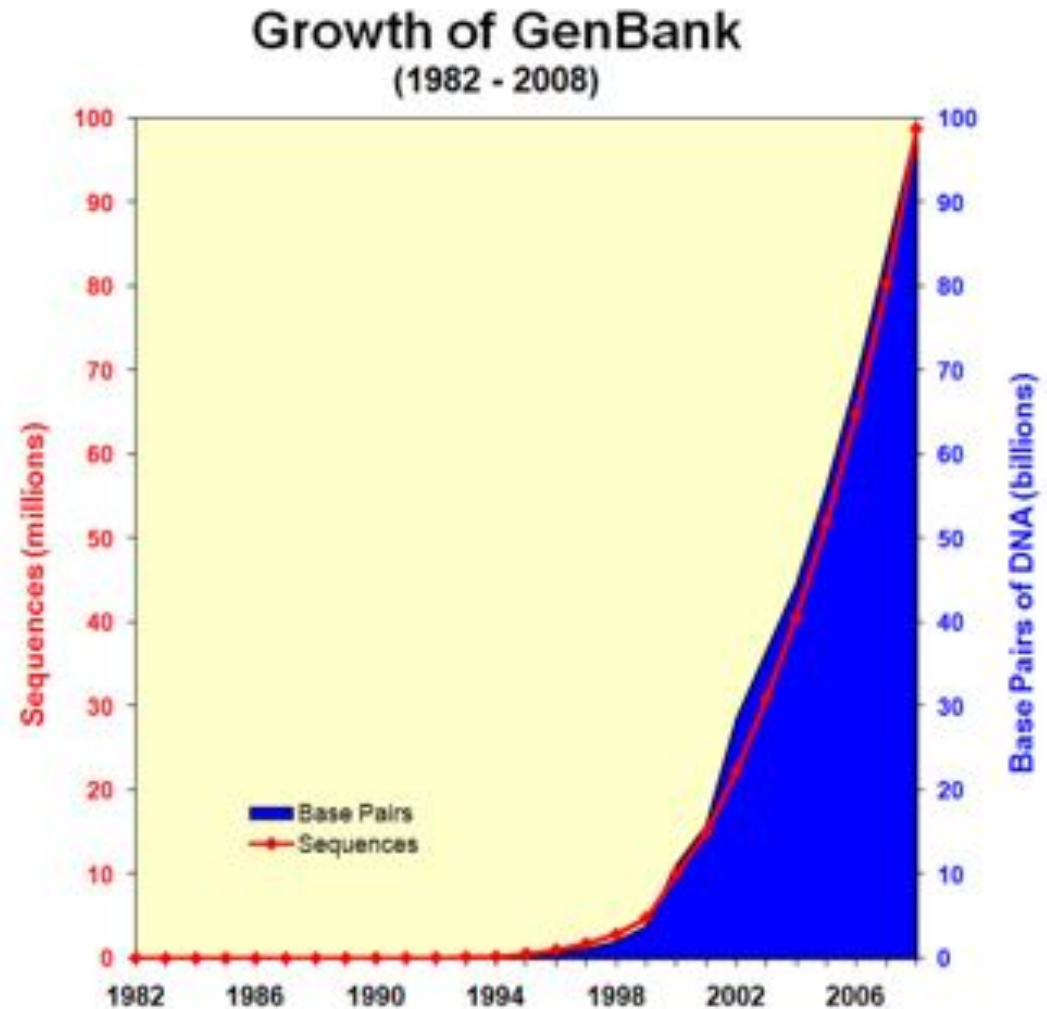
# Routine access to complete biomedical literature



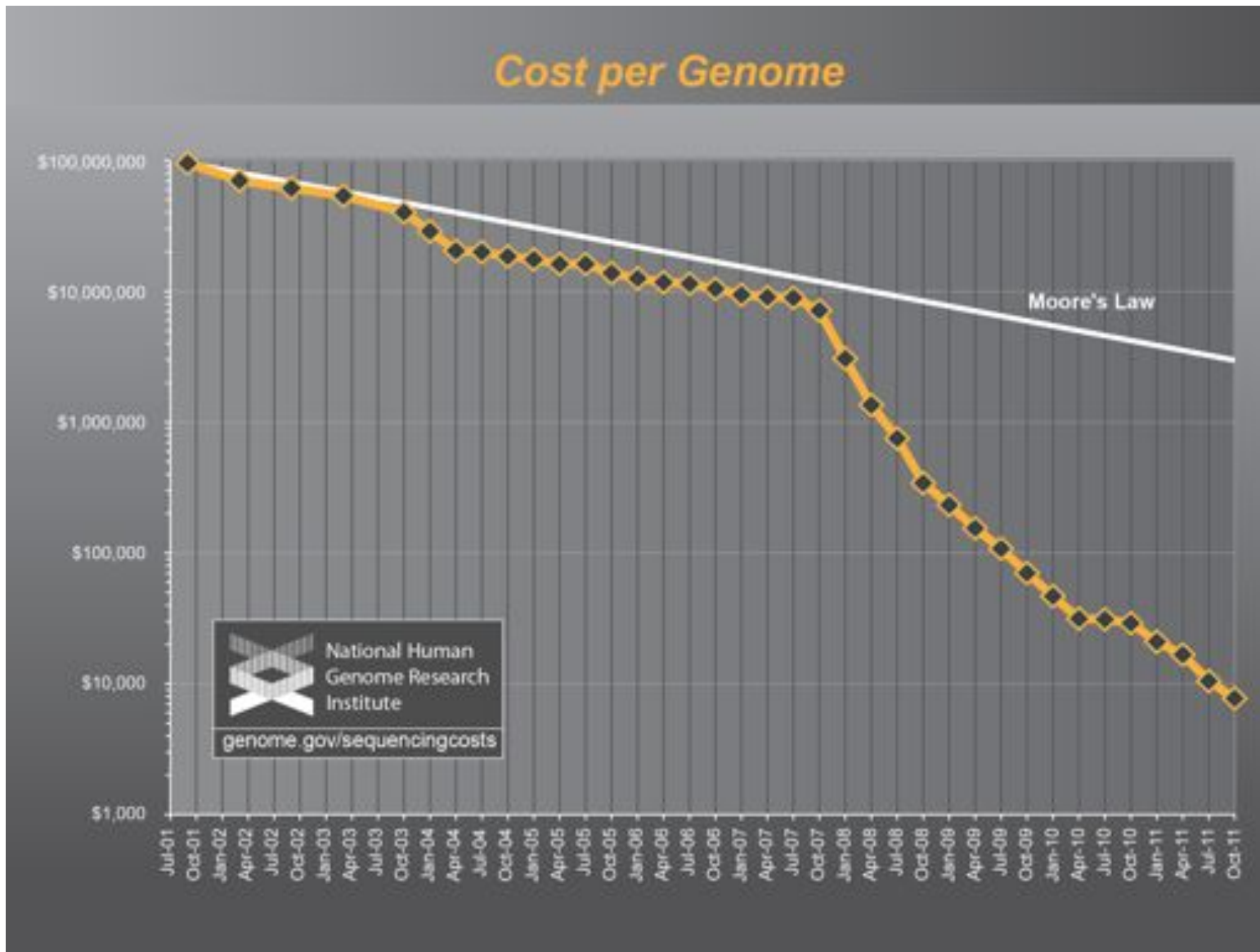
NCBI/NIH

# Freely available large stores of DNA, protein, metabolite data

National Center for  
Biotechnology  
Information (NCBI) at  
National Library of  
Medicine (NLM), NIH



# DNA sequencing outpacing Moore's law





# High precision simulations of 3D dynamics of molecules

Clusters, Screensavers, GPUs...getting to biological timescales.

Folding of Villin protein.

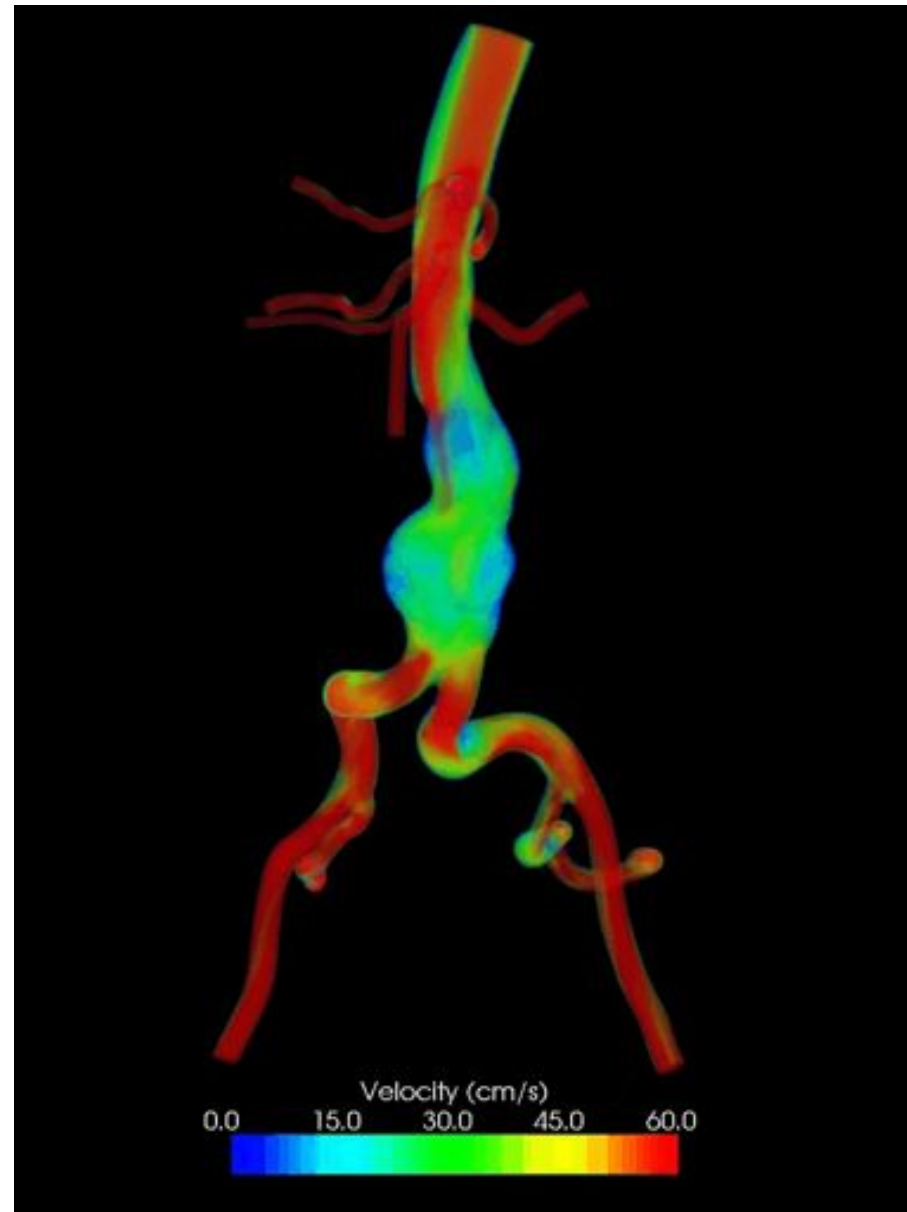
Vijay Pande,  
Stanford Dept of Chemistry



# Biomedical image data moving through hospitals every day

3D reconstruction of abdominal aortic aneurysm with simulation of arterial blood flow.

Charles Taylor  
Dept of Bioengineering  
Stanford University  
&  
HeartFlow Inc.

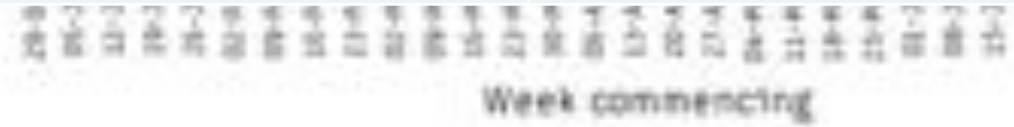


# Crowd sourcing for detecting disease, drug interactions, patient support

FIGURE 3

Influenza-like illness (ILI) from GP sentinel surveillance, *Multinational Medical Research Society and Canada, The Toronto*

Drugs in search with...	All words associated with hyperglycemia	More specific words associated with
Paxil ONLY	11.3% (1.4x)	
Pravachol ONLY	7.8% (1x)	
Paxil & Pravachol	25.7% (3.3x)	



patientslikeme®

oknowwhat shared a forum post

131,854 patients  
1000+ conditions

Who's like you?

Share your experience.  
The more you share, the easier it will be to find patients like you. Start by adding a condition, symptom or treatment.

You have questions about your condition? Helping others change theirs.

By learning from other patients like you...

## Two data trends

Basic biological measurements of genome and biomarkers (metabolites, proteins) are getting smaller, cheaper and more accurate.

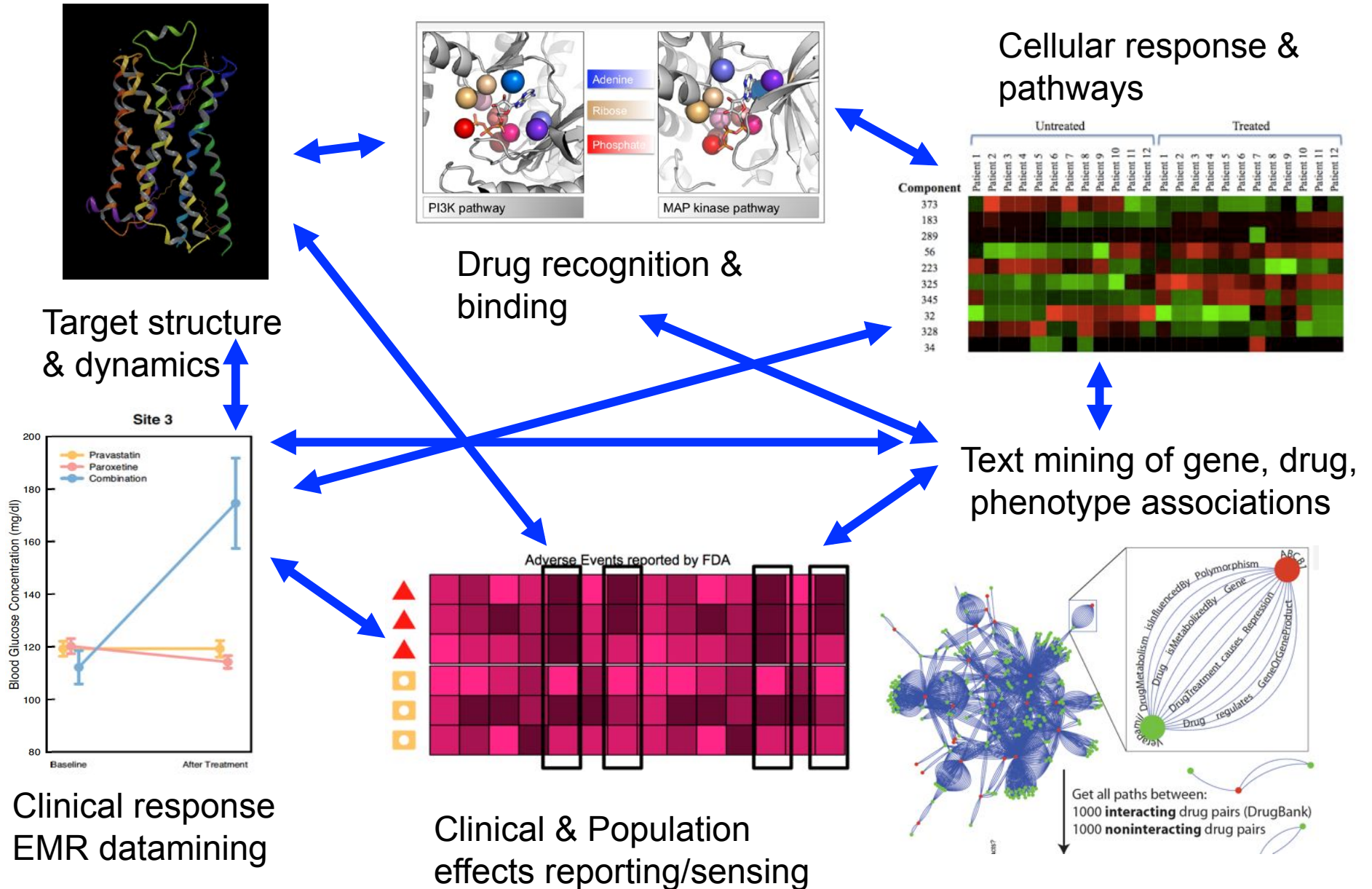
Healthcare system is increasingly instrumented with electronic medical records, capture of individual patient physiology

## Emerging challenges

Measure, store and integrate big data ranging from the molecular and organismal level.

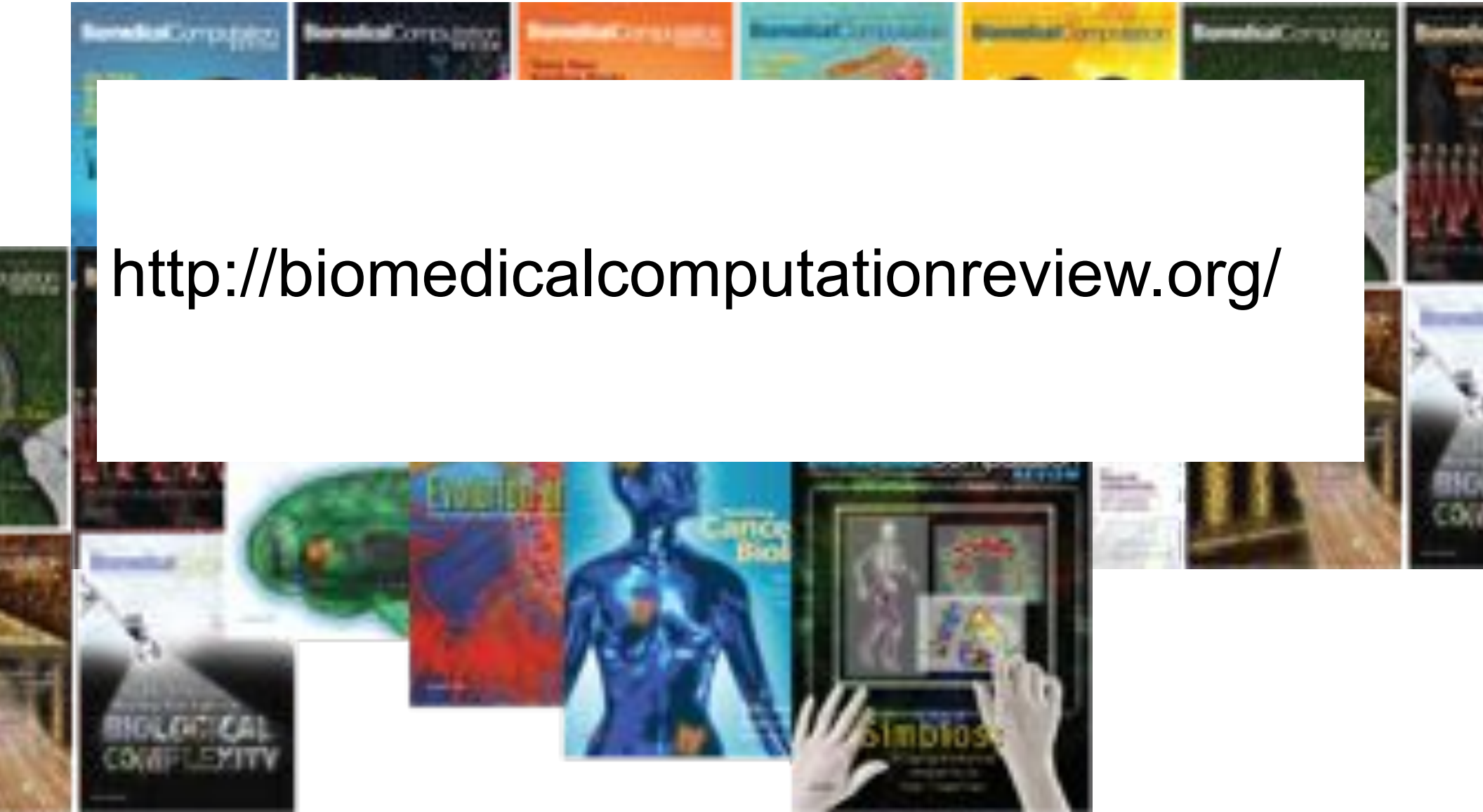
Discover patterns that allow us to improve diagnosis, prognosis and treatment = personalized medicine.

# Thus, the emerging network of data....



# Biomedical Computation Review

<http://biomedicalcomputationreview.org/>



Thanks!

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