



The role of Medical Imaging in Information Based Medicine

"2nd Seminar of Medical Image and Information technologies"

Sabadell Universitat

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Agenda

- Information Based Medicine
- New trends and challenges in Medical Imaging
- IBM solutions
- Key references

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Information is a key enabler in realizing the IOM's vision of the 21st-Century Health Care System

Today's Approach

- Care is based primarily on visits
- Professional autonomy drives variability
- Professional control care
- Information is a record
- Decision making is based on training and experience
- Do no harm is an individual responsibility
- Secrecy is necessary
- The system is reactive to needs
- Cost reduction is sought
- Preference is given to professional roles over the system

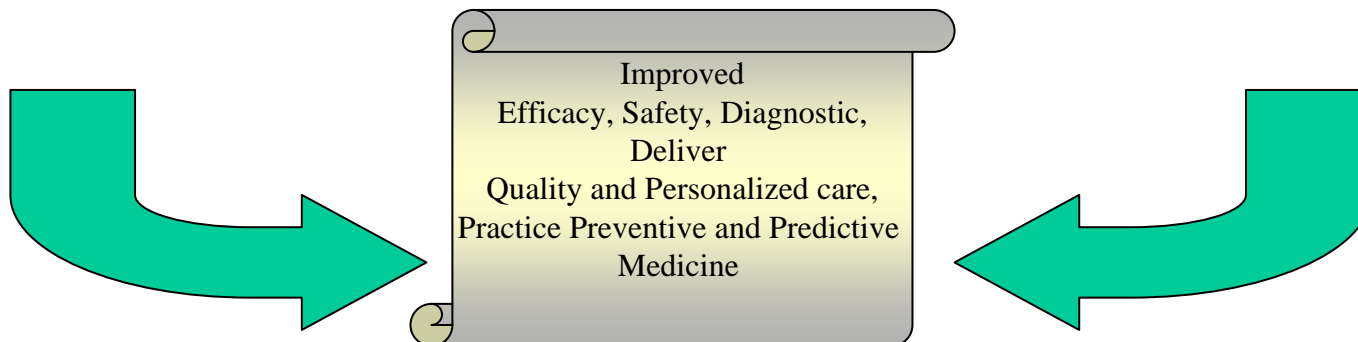
Future Approach

- Care is customized according to patient needs and values
- Knowledge is shared and information flows freely
- Decision making is evidence-based and computer assisted
- Safety is a system property responsibility
- Transparency with privacy are necessary
- Needs are anticipated – the system is proactive
- Waste is continuously decreased
- Cooperation among clinicians is a priority

Information Based Medicine

Information Based Medicine is an approach to medical care that supplements existing medical practice with insights gathered from computerized analysis of diverse clinical and research biomedical data. Information Based Medicine will improve patient health cost-effectively by factoring larger amounts of information into health care decisions.

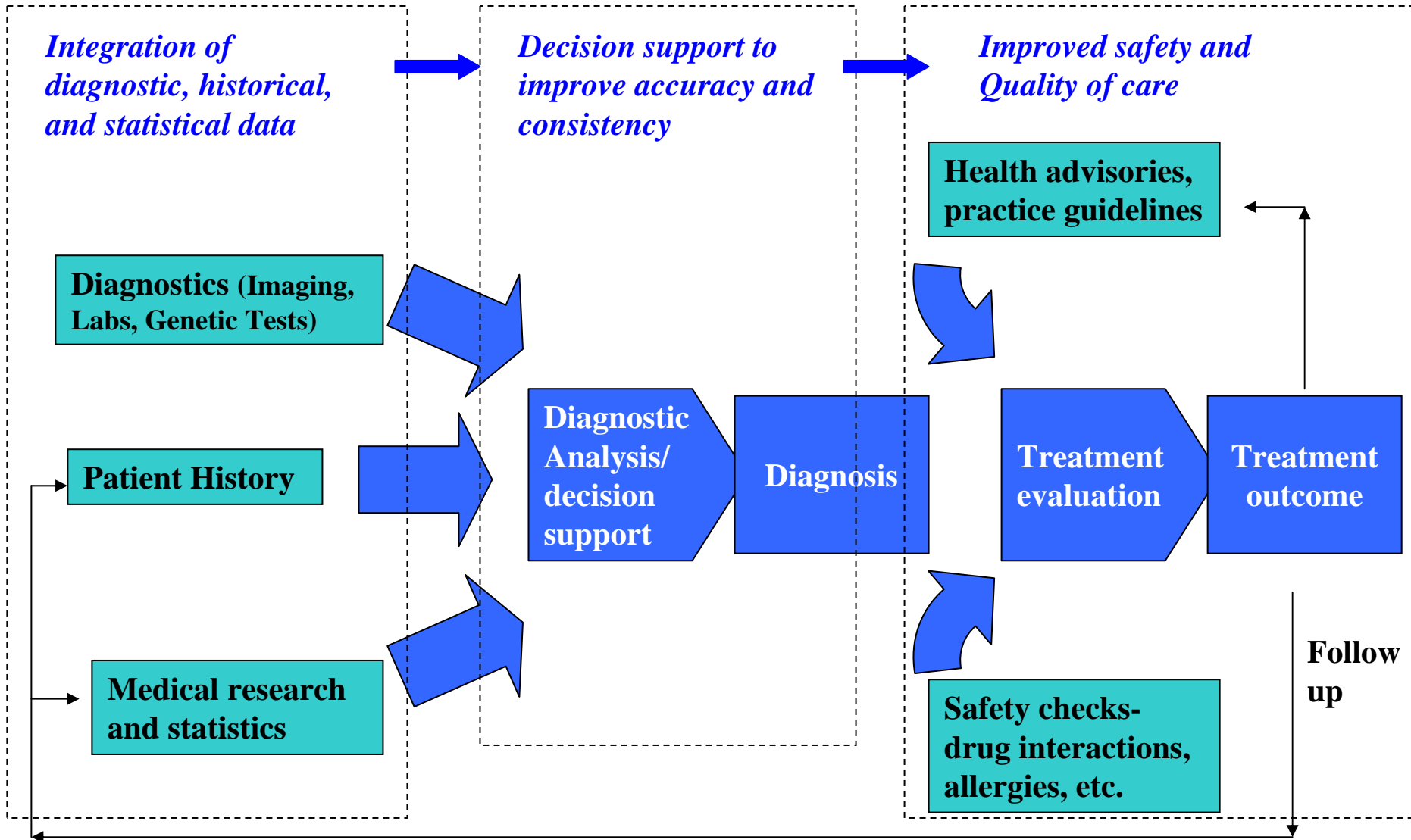
*The goal of Information Based Medicine is to improve treatment outcomes by improving the accuracy of diagnostic decisions and selecting the best treatment options. Information Based Medicine's ecosystem is composed of players involved in the diagnosis and treatment of disease as well as the providers of electronic infrastructure necessary for personalized health care. Ultimately, Information Based Medicine is the **foundation for fully realized Personalized Health Care.***



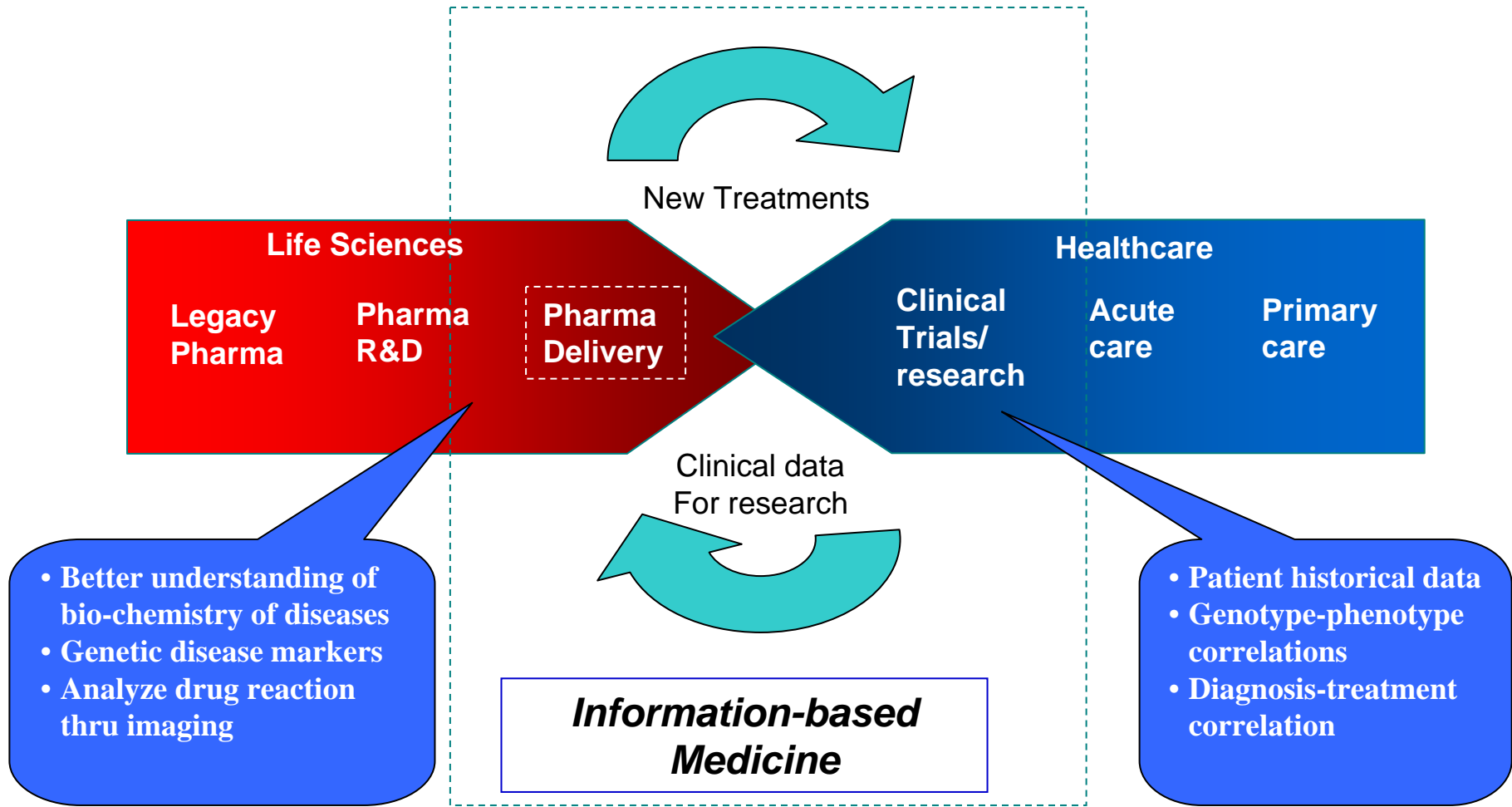
Information Based Medicine

- Information Based Medicine will advance the boundaries of medicine along three dimensions.
 - Care Delivery will be improved through readily accessible, integrated clinical information
 - Medical Capabilities will be expanded through strong interaction between Healthcare and Life Sciences research
 - Medical Administration – Open standards-based Information sharing is the key to effectiveness

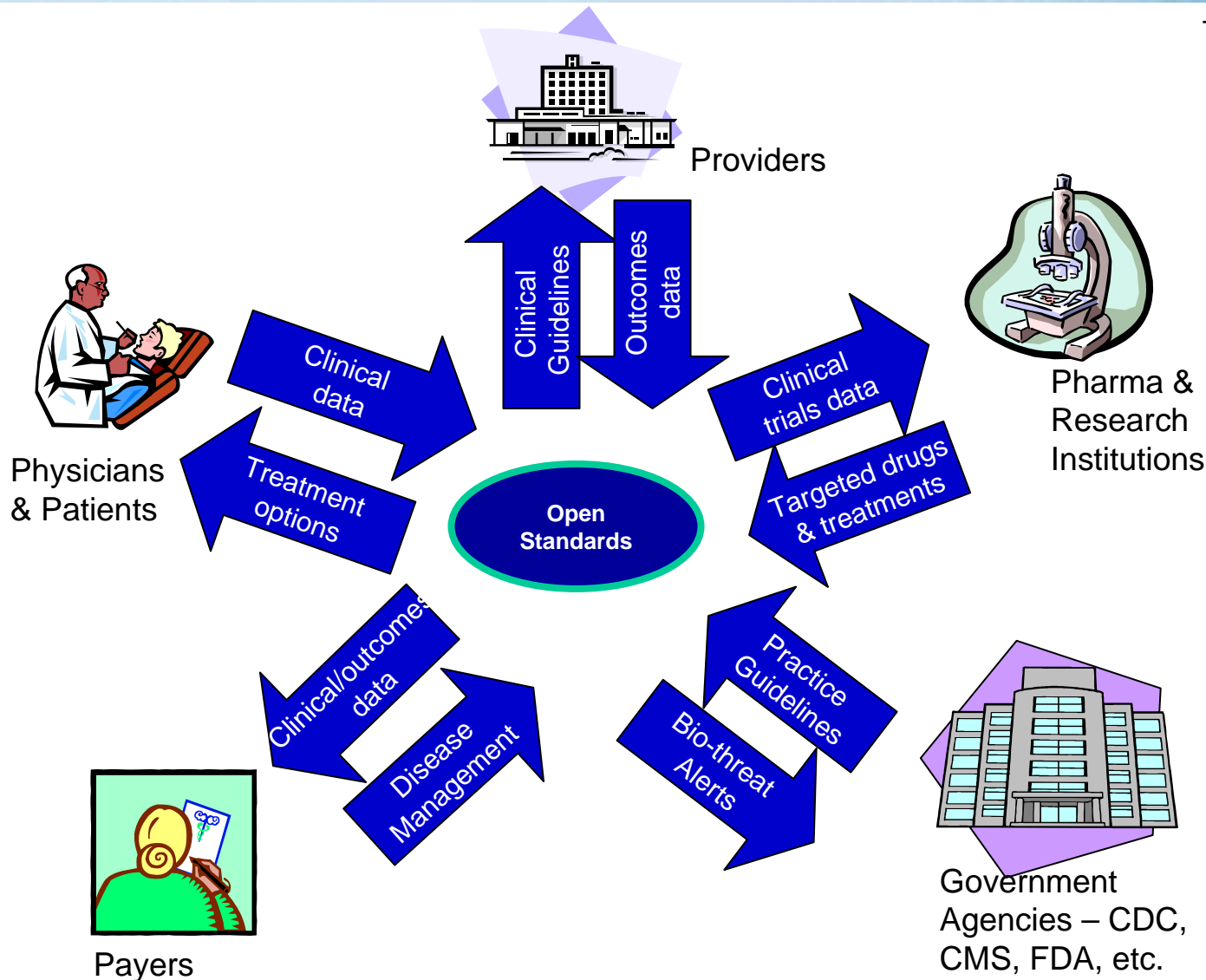
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New trends in Medical Imaging

- *New advanced imaging systems require real-time high-performance computing resources. Advances in high-performance microprocessor technology have produced and will increase the availability of low cost components suitable for use in high-performance computing systems.*
- *As a result, high accurate devices that can look inside the body, travel in the body, and construct 3D images in real-time*
- *Impact on medical industry*
 - *Future operation room: Use of real-time 3D imaging in the operation room*
 - *Non-invasive medicine: Use of real-time 3D imaging to perform non-invasive treatment which can be therefore performed locally or remotely*
 - *Education: Use of real-time 3D imaging for simulations to assist in education and analysis of medical treatments, surgery, and telemedicine*
 - *Diagnosis: Diagnosis assisting tools, Screening tools,*
- *Recent developments in computation technology have fundamentally enhanced the role of medical imaging, from diagnosis to computer assisted surgery (CAS).*
- *Medical imaging methods have grown from their initial use as physically based models of human anatomy, to applied computer vision and graphic techniques for planning and analyzing surgical procedures and for the use of simulation as part of health care education and research.*
- *Medical imaging capabilities enable OnDemand Diagnostic, telemedicine, teleradiology, and telesurgery.*

Medical Imaging Diagnostic and Therapeutics within Information Based Medicine Life-Cycle

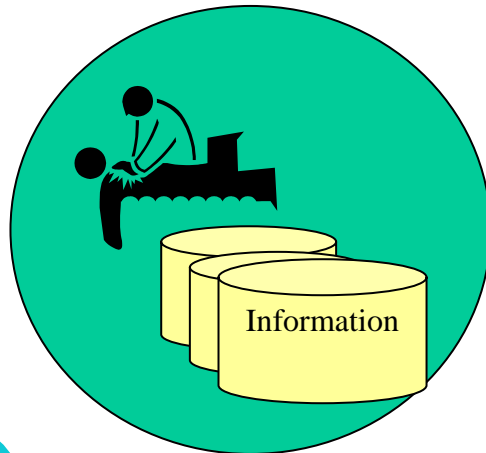
CAD

Computer Assisted Diagnostics



Medical information is the source for diagnosis

Patient is the source of medical information



New treatments are applied on patients and generate new information

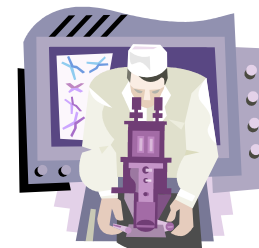
Minimal Invasive Surgery

Non-Invasive Surgery



CAS
Computer Assisted Surgery

Medical treatment is using the information in proactively, in real-time, and re-actively



Medical research uses patient information, diagnosis and treatment to innovate and develop new treatments and new devices

Multi-disciplinary Research



New treatments and devices are tested and produce additional information from clinical trials

Challenges in the Medical Imaging Domain

- **All**

- *Very large medical archives – indexing technology, video technology, real-time streaming, network bandwidth utilization*
- *Large storage requirements – reliable storage management*
- *Heterogeneous data sources in real-time and data integration*
- *Network optimization technology*
- *HCI – Human Computer Interface*

- **Care delivery**

- *Image recognition, screening tools and analysis tools*
- *Decision support systems using automatic target recognition*
- *High resolution displays*
- *Remote Diagnostics*

- **Medical capabilities**

- *Microprocessors, nano technology*
- *Visualization technology*
- *Robotic Technology*
- *Minimal Invasive and Non-Invasive Surgery*

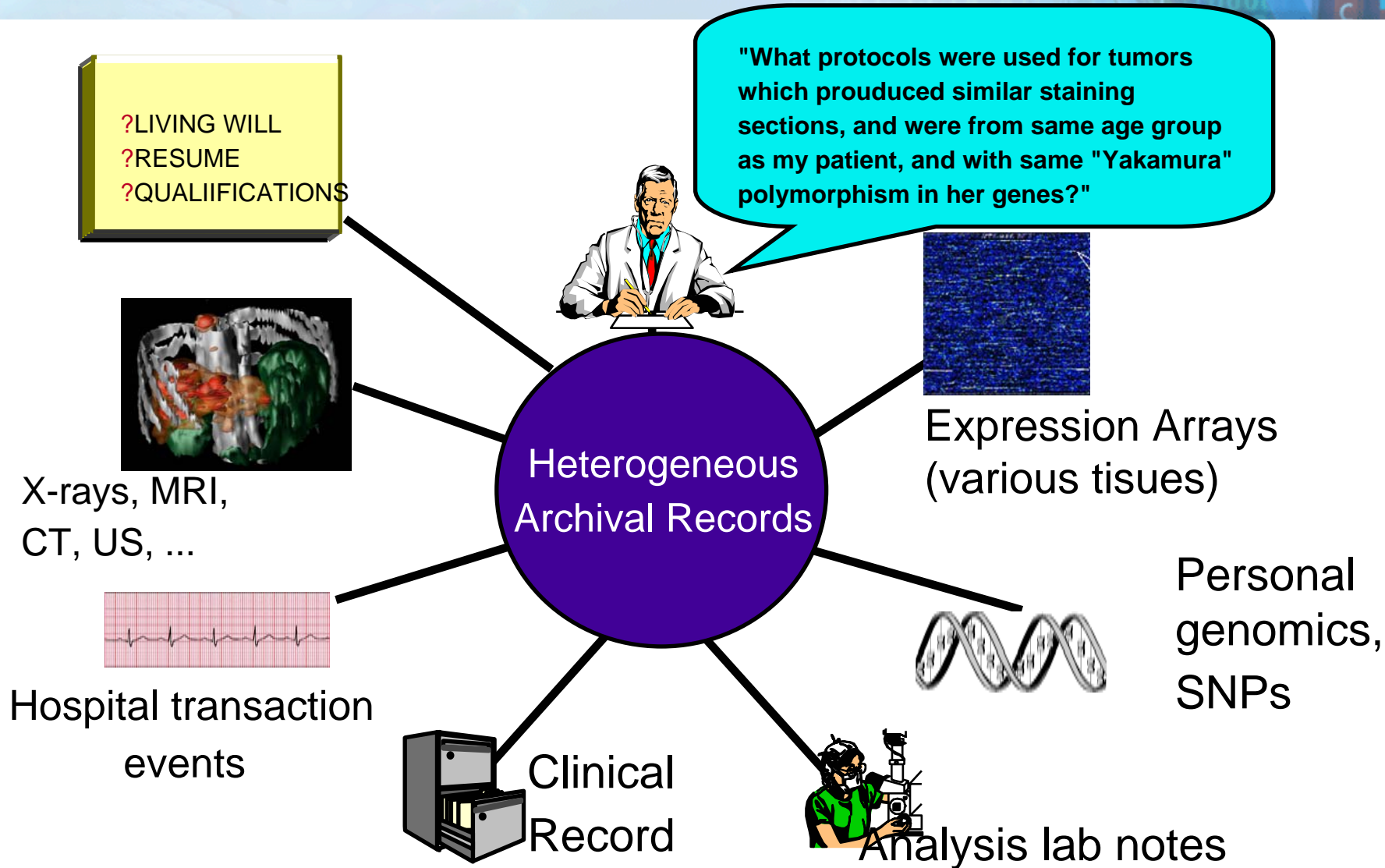
- **Public health**

- *Telemedicine*
- *Large scale administration*
- *Security and privacy in large scale*
- *Large scale Device Management and monitoring*
- *Event management*

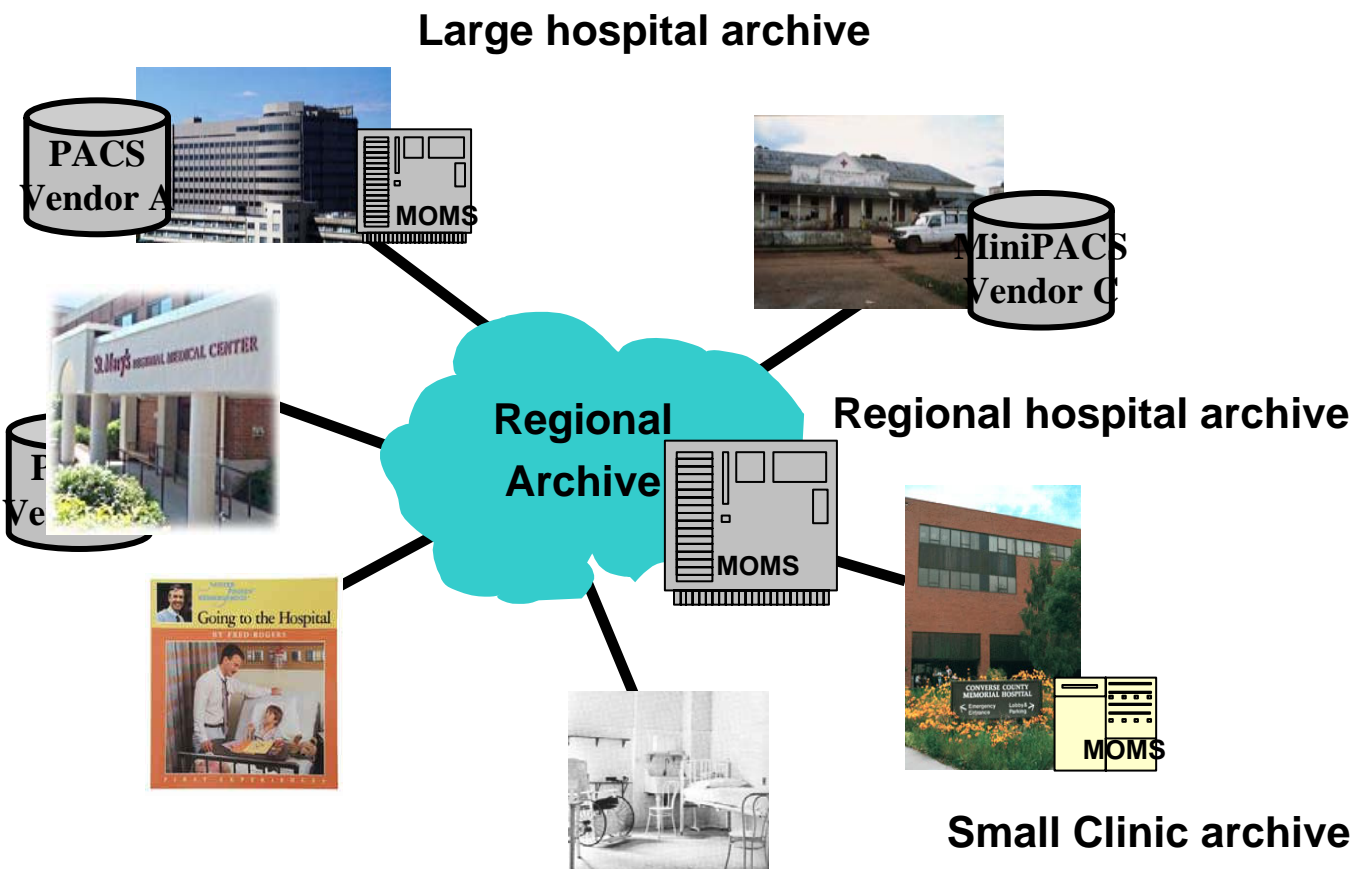
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Medical Information Integration - Discovery Link

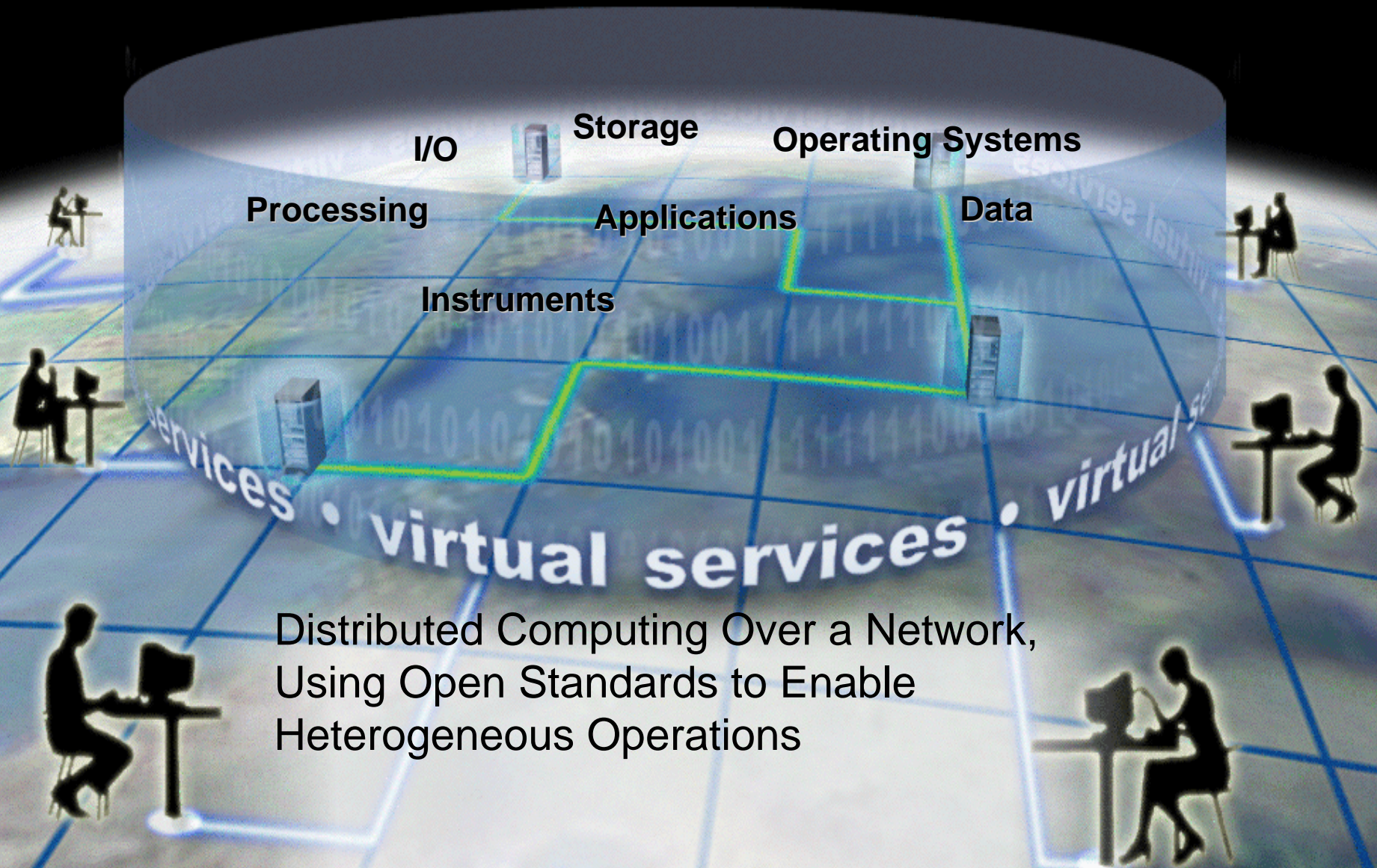


Medical Objects Management Subsystem (MOMS) provides a scalable long-term shared archive from small clinic to large hospital as well as regional hospital networks or large healthcare archives

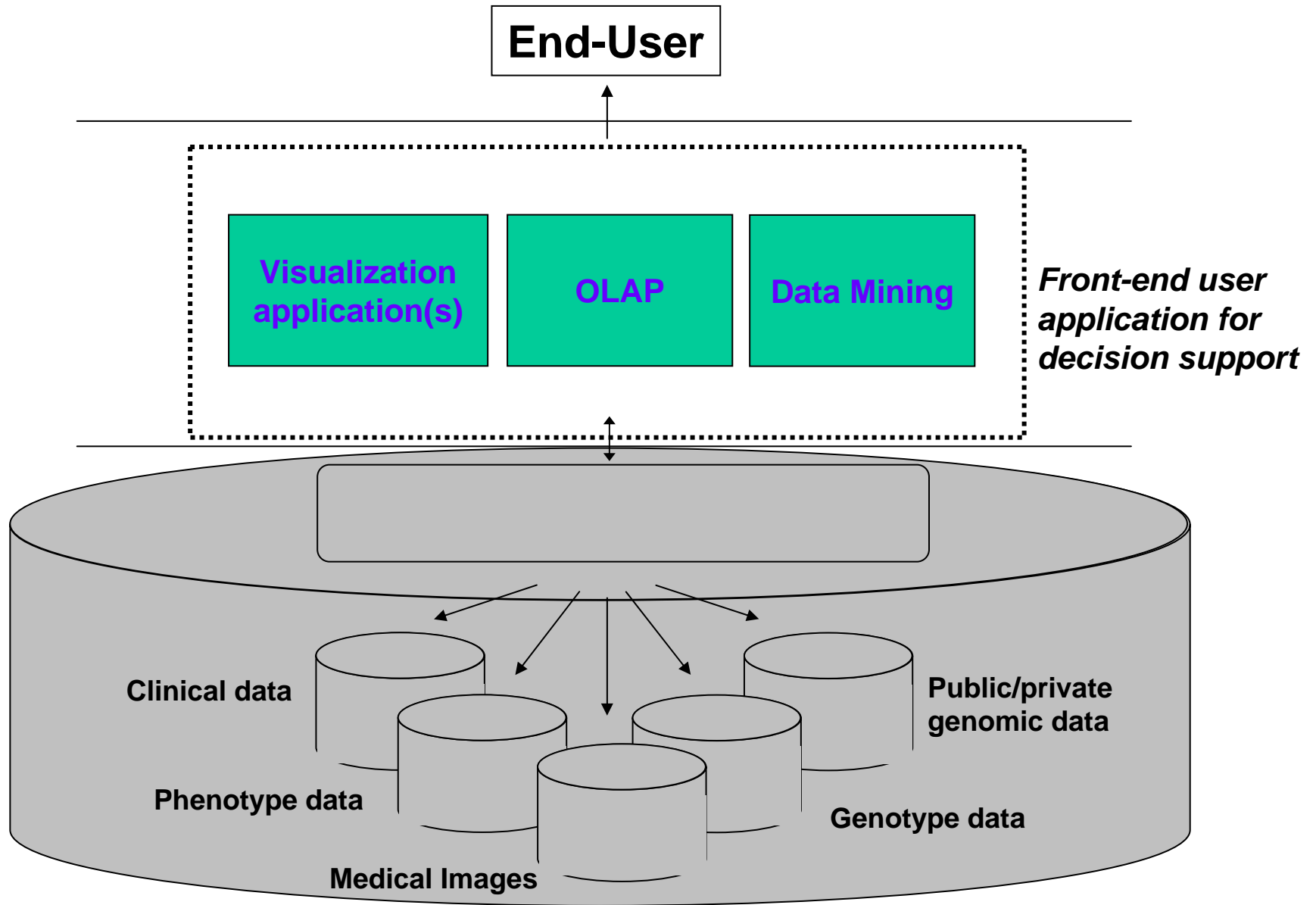


- *Policy Based*
- *End-to-end object management*
- *Distributed system*
- *Scalable*
- *Reliable*
- *High Performance and Throughput*
- *Disaster Recovery*
- *24x7*
- *EAIbus*
- *DICOM, HL7, and IHE support*
- *Based on top-seller IBM products (WAS, WMQ, DB2, TSM)*

Hiding Complexity: Grid Computing



Integrated Clinical Genomics platform



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IBM/Mayo Clinic Collaboration

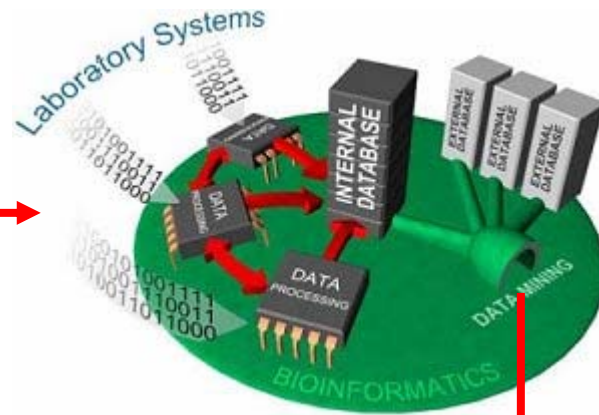
Applied Genomics Data Analysis



Genomic data (DNA) – GeneChip array data (RNA)
Protein data

Clinical Data

Signs
Symptoms
Laboratory
Radiology
Etc.



Databases

Genome
Proteome
Disease
Tumors
Drugs

Optimized, individualized healthcare



IBM/Mayo Clinic Collaboration

Example of a real-time query



- **Find all patients with:**
 - **Coronary artery disease** (*a form of heart disease*)
 - **Diabetes Mellitus** (*“diabetes”*)
 - **Nonalcoholic steatohepatitis** (*a form of liver disease*)
 - **Who had a breast biopsy at Mayo** (*a procedure*)
 - **In ZIP code 55901, 55902, 55903, 55904** (*local region*)
 - **Between 45 and 65 years of age** (*certain age*)
 - **Who are female** (*female gender*)
 - **And are alive** (*vital status*)

Mayo researcher benefit – months to minutes time savings for select cases tested



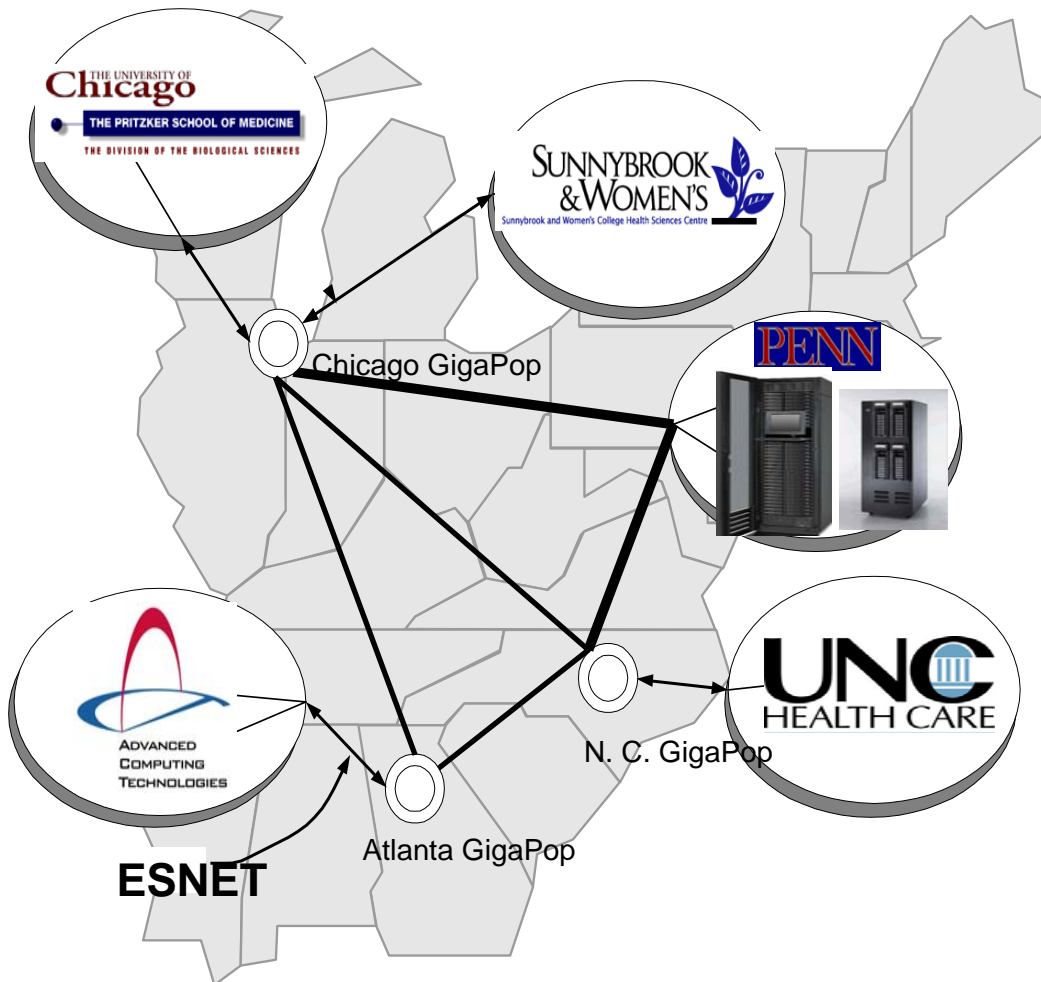
IBM/Mayo Clinic Collaboration

Cooperation Scope



- **Warehouse contains 4.4M+ patient records**
- **Infinite number of unique queries across**
 - 28 demographic elements
 - 523 DRG codes
 - 10,455 ICD-9 codes
 - All structured laboratory test conditions or results (up to 4900+)
 - All microbiology organisms by name; heart rate on ECG
- **Storage and Retrieval of Genomic data**
 - Genomic data storage and retrieval utilities incorporated into the data warehouse
- **Genomic Data Analysis Workflow**
 - Genomic data workflow encompassing DNA/RNA test results, analysis of raw data (e.g., microarray), with annotation/comparison to reference databases and inclusion in study list prototype application
- **Text Analysis**
 - Concept-based inquiry and retrieval of unstructured data in Clinical Notes and Laboratory Reports

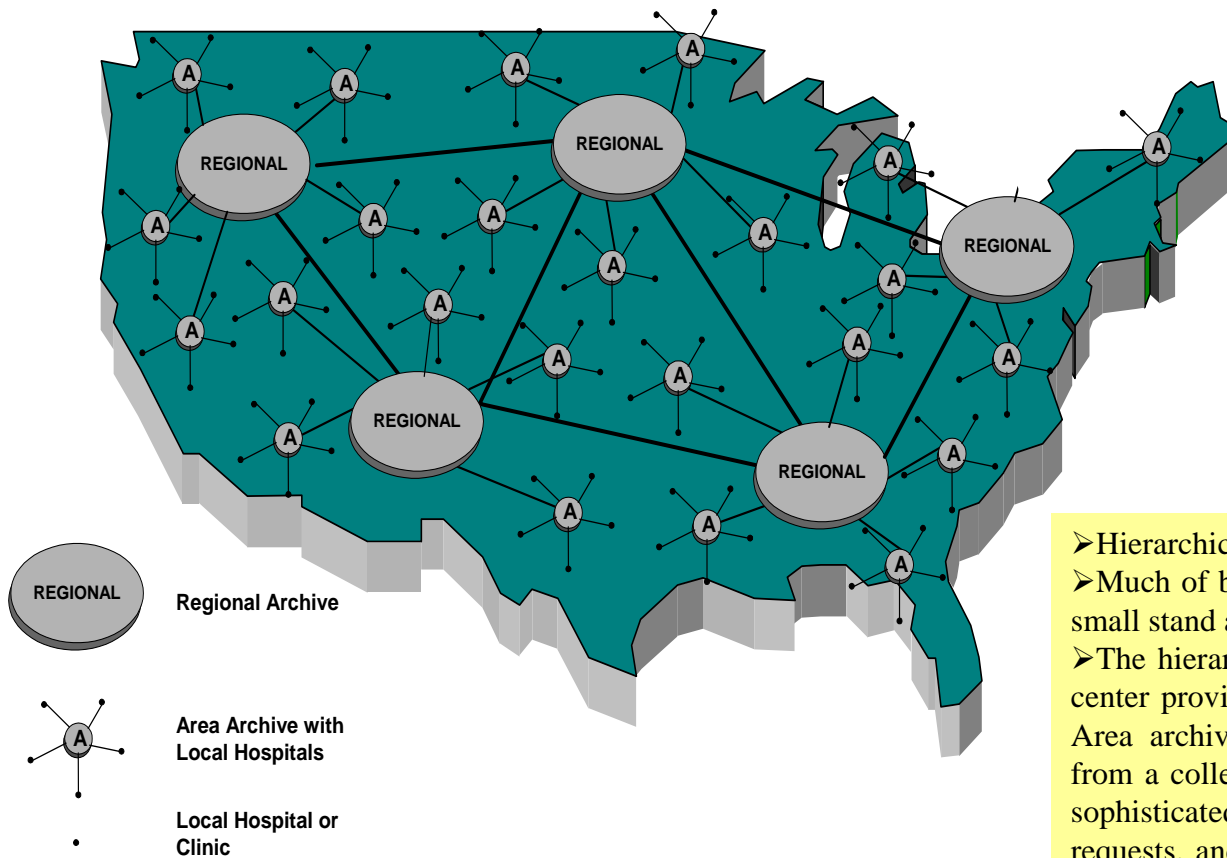
National Digital Mammography Archive (NDMA)



- Patient centric medical record system that captures the full patient data (text and images)
- Online Archive with fast access
- Data-analysis over overall data,
- Computer Assisted Diagnostics as service
- Training and education for Radiology Departments

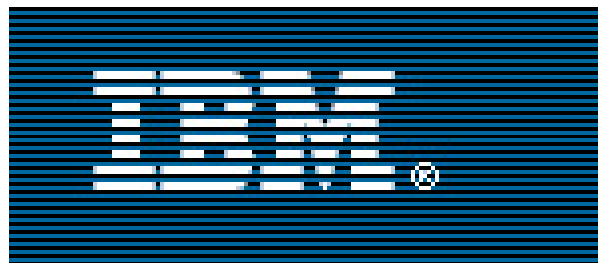
IBM contributing technology & skills: DB2, GPFS, GLOBUS, AIX, Linux, Intel, Power

Next step: Medical Imaging Grid National Archiving Network



- Hierarchical model rather than a fully distributed model.
- Much of breast imaging performed today is practiced in small stand alone centers ,
- The hierarchical model has small scale systems at each center providing some local cache, larger systems (called Area archives) that aggregate traffic, files and requests from a collection of geographically "nearby" centers, and sophisticated Regional archives that aggregate traffic, and requests, and replicate each other over the network at the highest level.
- Regional archives would serve as back-ups to at least one other regional archive, and would need the ability to share a private network space to maintain heavy movements of traffic between the various components of this proposed national grid.

eDiamond - Mammography Archive in UK



Oxford Radcliffe Hospitals
NHS Trust



Scottish Breast Screening Programme