Speeding Research and Development through a Collaborative Ecosystem

Collaborative Innovation in Biomedicine
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Today's Take-Away Messages

- All research-driven organizations need to improve the speed, efficiency and productivity of their research to increase ROI
- Traditional methods of conducting research and clinical development are "disconnected", repetitive, wasteful, and unsustainable
- It is already completely feasible TODAY to adopt a data-driven, collaborative approach to R&D
- NCI has devised a 21st century model -- encompassing Community, Content, and a Connectivity platform -- that can be adopted with minimal disruption to meet biopharma's needs in all therapeutic areas

The Research & Development Continuum

Information is highly fragmented within organizations and across the community

20th Century Biomedical Paradigm

Discovery
- Biological pathways
- Target identification and validation

Product Development
- Candidate selection and Optimization
- Pre-clinical testing
- Phase I, II, III
- New Drug application and Approval

Clinical Care
- Product launch
- Clinical adoption

Outcomes & Surveillance
- Reporting of serious/fatal ADRs
- Re-labeling (or recall) as needed
- Additional indications as warranted
-

20th Century Biomedical Paradigm

Current paradigm is linear, sequential, slow, cost-ineffective, and minimally productive. The data from each stage is "disconnected" from other stages. It does not capture value of clinical data, or leverage knowledge for discovery or clinical impact in a timely way.

Discovery
Issues:
It's difficult to:
- Access clinical outcomes data on relevant populations
- Access biospecimens of high quality with clinical data
- Validate *in silico*

Product Development
Issues:
- Linear, sequential process
- Information is trapped in silos
- Each trial demands re-creation of infrastructure
- No economies of scale
- Failed candidates hard to resuscitate

Clinical Care

Issues:

- Launches and product detailing are costly
- Adoption can be slow
- Traditional physician outreach methods now constrained
- Process is slow and uni-directional

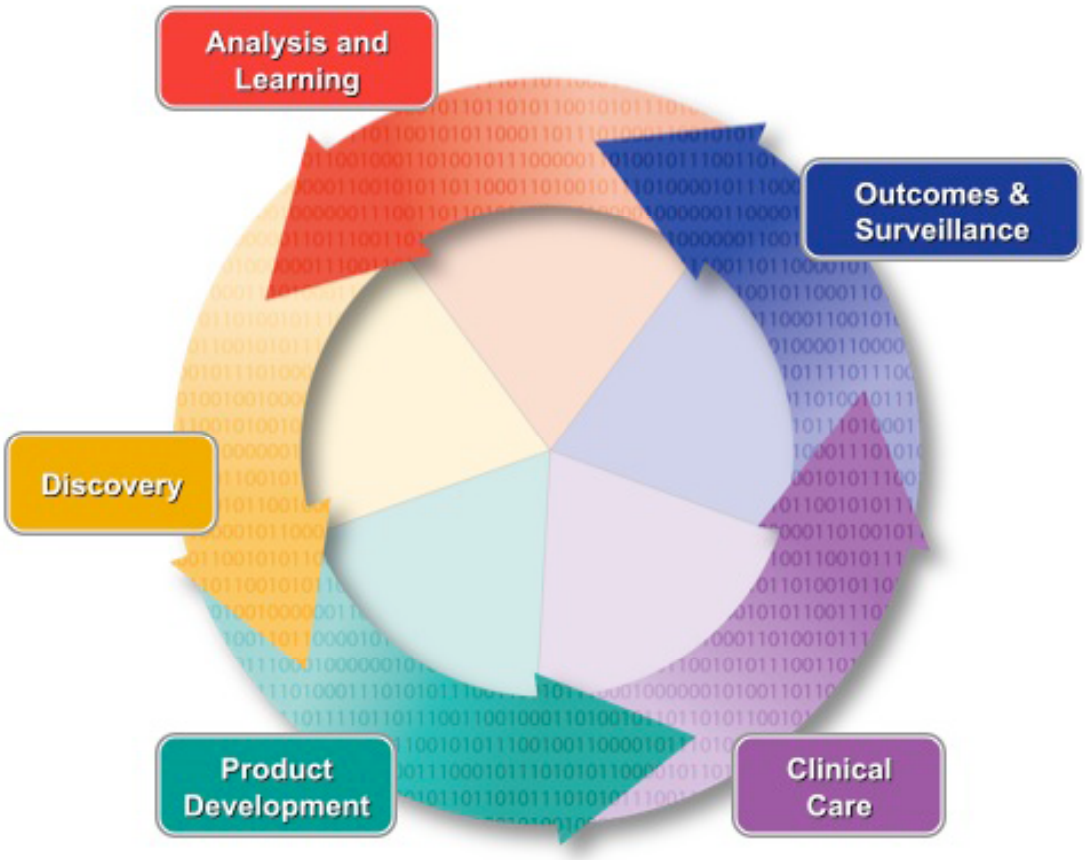
Outcomes & Surveillance

Issues:

- Ph IV not conducted uniformly or consistently
- Efficacy and ADR patterns are recognized very slowly
- New indications are gained painstakingly from regulators
- Recalls are financially disastrous

Information on clinical experience with products is not captured systematically. Observations are "locked away" or ignored, and little new knowledge is gained or leveraged.

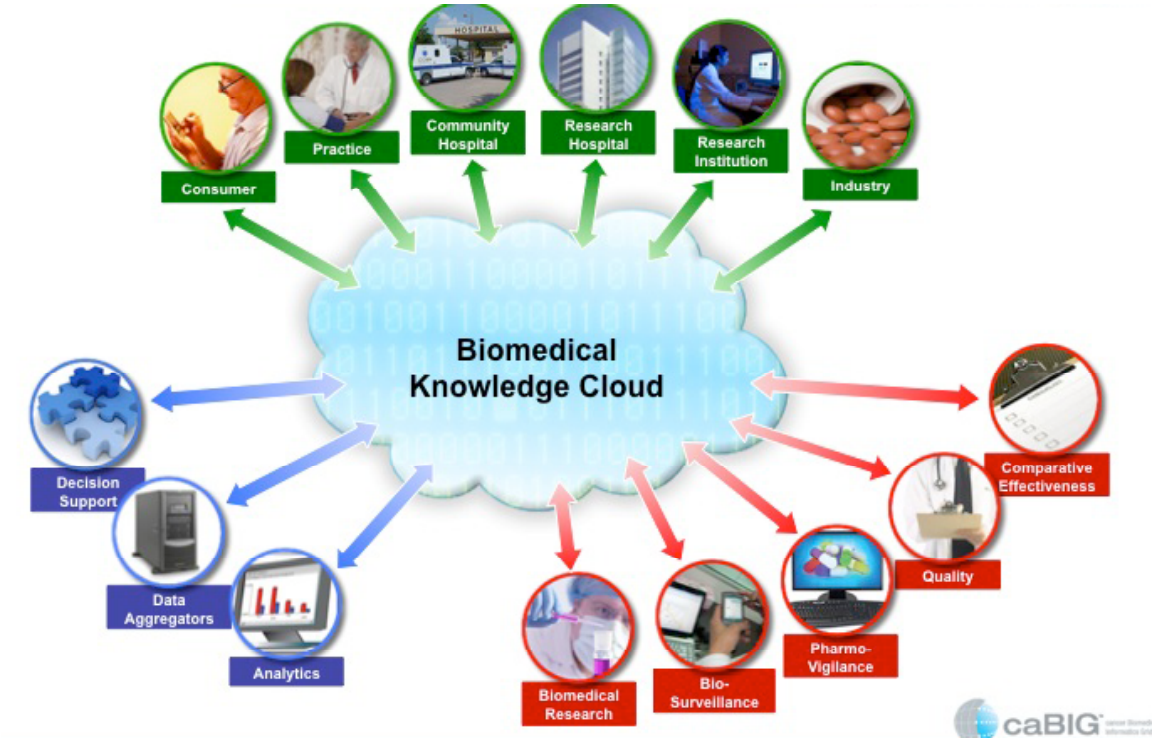
21st Century Biomedical Paradigm



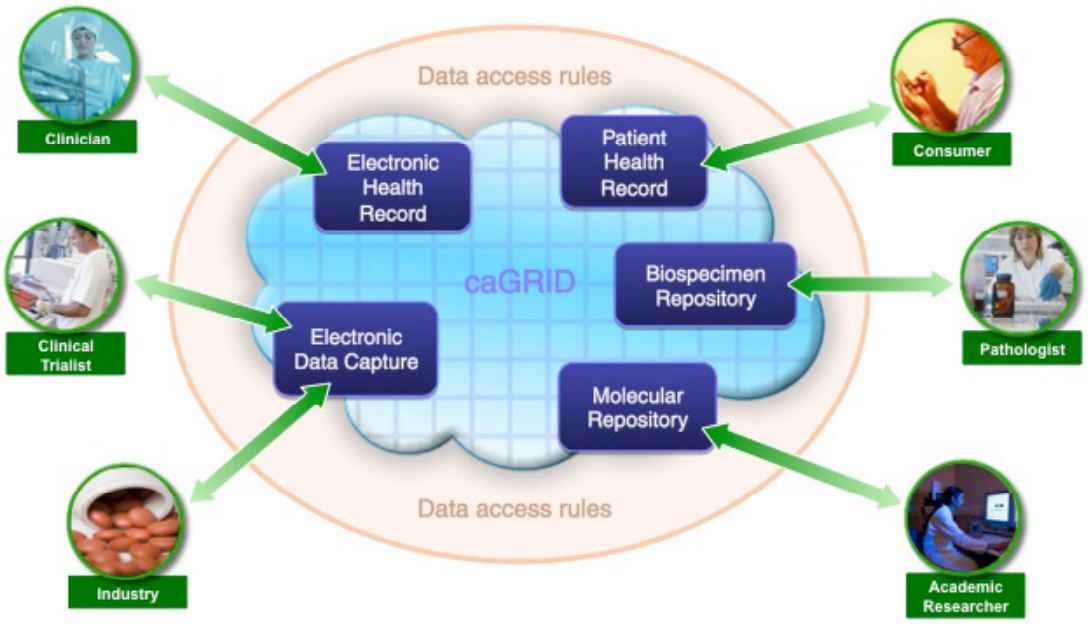
Biomedical Knowledge Cloud:
A Model for Interconnecting Research, Development and Care

The Biomedical Knowledge Cloud is a virtual biomedical capability that uses the NCI's informatics platform to connect distributed individual and organizational data, software applications, and computational capacity through the Internet.

The Knowledge Cloud Enables A New Kind of Data-Driven Collaboration



All Participants in the Knowledge Cloud Contribute and Use Data



caBIG® enables the Biomedical Knowledge Cloud

- **caBIG® (cancer Biomedical Informatics Grid) is an informatics platform that:**
    - Links all functions in the R&D continuum within a biopharm organization
    - Enables the capture/reuse of data from all research projects
    - Enables connectivity among researchers and care providers to facilitate data capture and access to patient populations
- **caBIG® is comprised of:**
    - 40+ Software Tools, Grid infrastructure, data standards, policies and resources to adapt existing tools/systems
    - All of these can be easily extended beyond cancer to all therapeutic areas

caBIG® is a Platform to Link All Major Functions in the R&D Process

Clinical Research

- Track clinical trial registrations
- Facilitate automatic capture of clinical laboratory data
- Manage reports describing adverse events during clinical trials

Molecular Biology

- Combine proteomics, gene expression, and other basic research data

- Submit and annotate microarray data
- Integrate microarray data from multiple manufacturers and permit analysis and visualization of data

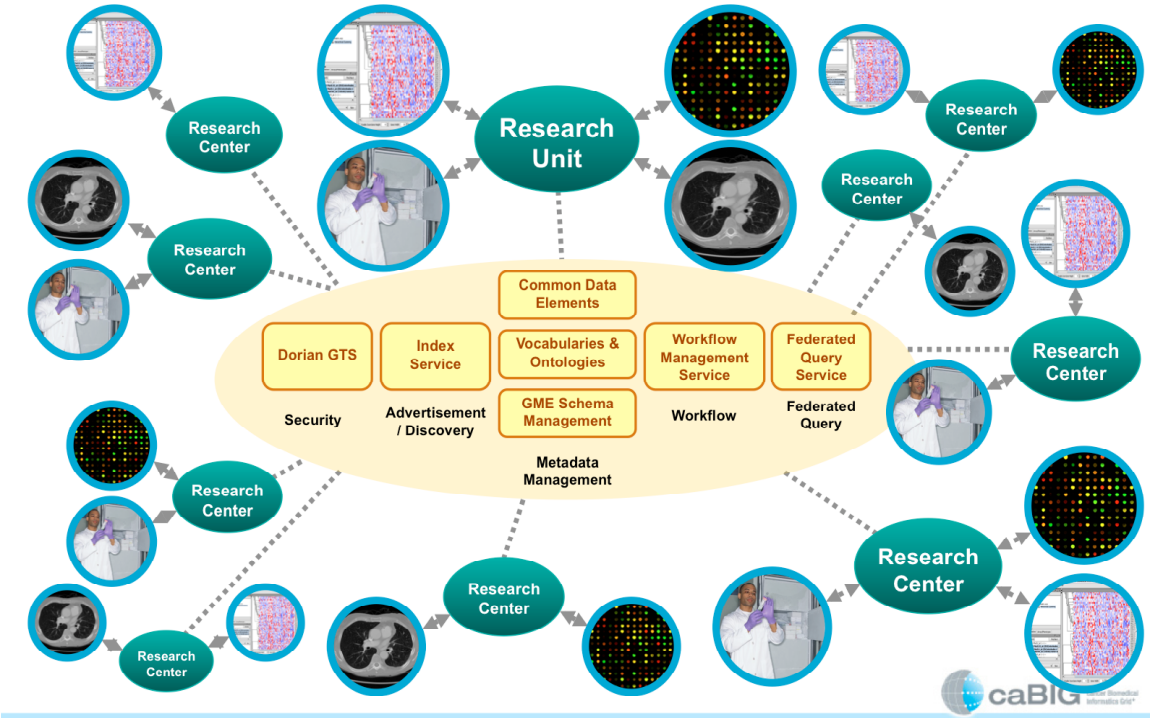
Imaging

- Utilize the National Cancer Imaging Archive repository for medical images including CAT scans and MRIs
- Visualize images using DICOM-compliant tools
- Annotated Images with distributed tools

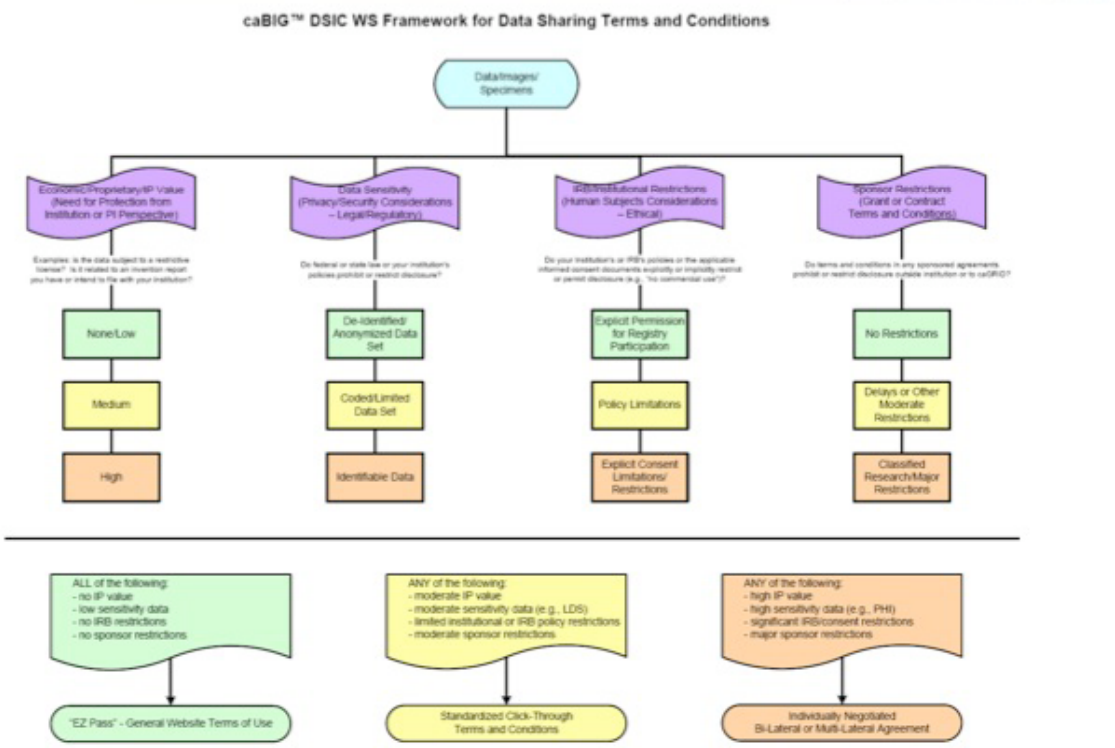
Pathology

- Access a library of well characterized, clinically annotated biospecimens
- Use tools to keep an inventory of a user's own samples
- Track the storage, distribution, and quality assurance of specimens

caGrid Conceptual View



Data Sharing Framework



National Biomedical Image Archive (NBIA)

NBIA is a repository for capturing, storing, managing and sharing medical images. Benefits include:

- Secure and de-identified acquisition of medical images from clinical imaging modalities or Picture Archiving and Communication Systems (PACS)
- Web-based access to DICOM-standard (Digital Imaging and Communications in Medicine) images, markups, and annotations using role-based security
- Ability to search studies utilizing specified imaging modalities and parameters
- Images can be stored and managed locally, and accessed locally or remotely as needed, reducing or eliminating physical or electronic data transfer to multiple sites
- Images can be queried as part of a large federated database regardless of physical location

Users: clinical researchers, bioinformaticians

National Biomedical Image Archive (NBIA)

caBIG® Imaging Enterprise Software

Annotation and Image Markup (AIM)

- First product to provide standardized markup for medical images, enabling interoperable sharing of images and associated metadata and annotations between multiple sites or researchers
- Users: clinical researchers

eXtensible Imaging Platform (XIP)

- Open-source platform serves as a tool for rapid prototyping of medical imaging workstation applications from a re-usable, extensible set of modular elements. By providing standardized components to create image analysis pipelines, the uniformity of imaging and analysis is improved, helping advance the use of imaging as a biomarker for subsequent trials
- Users: developers

Middleware

- Collection of middleware components providing interoperability with caGrid services, PACS (Picture Archiving and Communication Systems) and secure remote transfer of DICOM images

- Users: developers

Application of NBIA

Problem:

- Medical images are required as part of regulatory and reporting process of a clinical trial.
- How do you manage all the images collected at a variety of remote sites (CROs) without requiring a centralized repository?

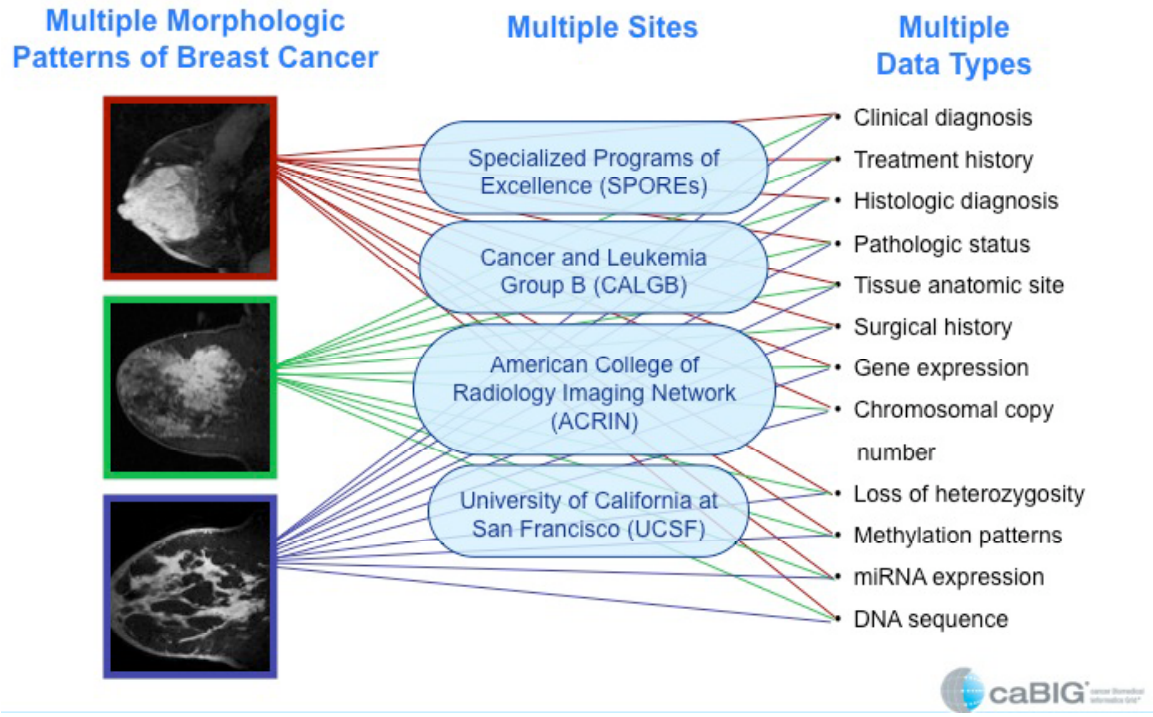
Solution:

- Install NBIA for image storage, and the In Vivo Imaging Middleware (IVI) and Annotation and Imaging Markup (AIM) software at each remote site. This allows each site to collect, store, annotate and distribute all the images they collect as part of the clinical trial,
- Connect the remote locations using caGrid so all images and their associated, standards-based annotations can be accessed on demand to satisfy regulatory and reporting requirements.

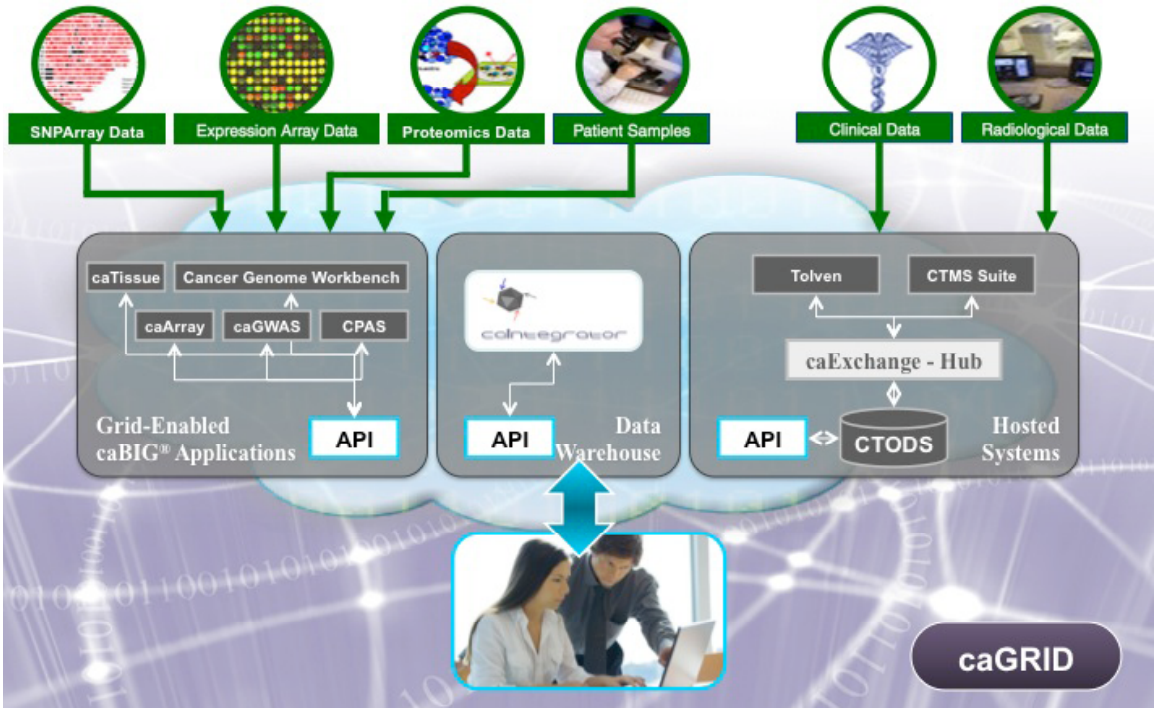
The I-SPY trial (Investigation of Serial studies to Predict Your Therapeutic Response with Imaging And moLecular analysis):

a national study to identify biomarkers predictive of response to therapy throughout the treatment cycle for women with Stage 3 breast cancer.
I-SPY Trial: Identify biomarkers predictive of therapeutic response in Stage 3 breast cancer

I- SPY Trial: Identify biomarkers predictive of therapeutic response in Stage 3 breast cancer



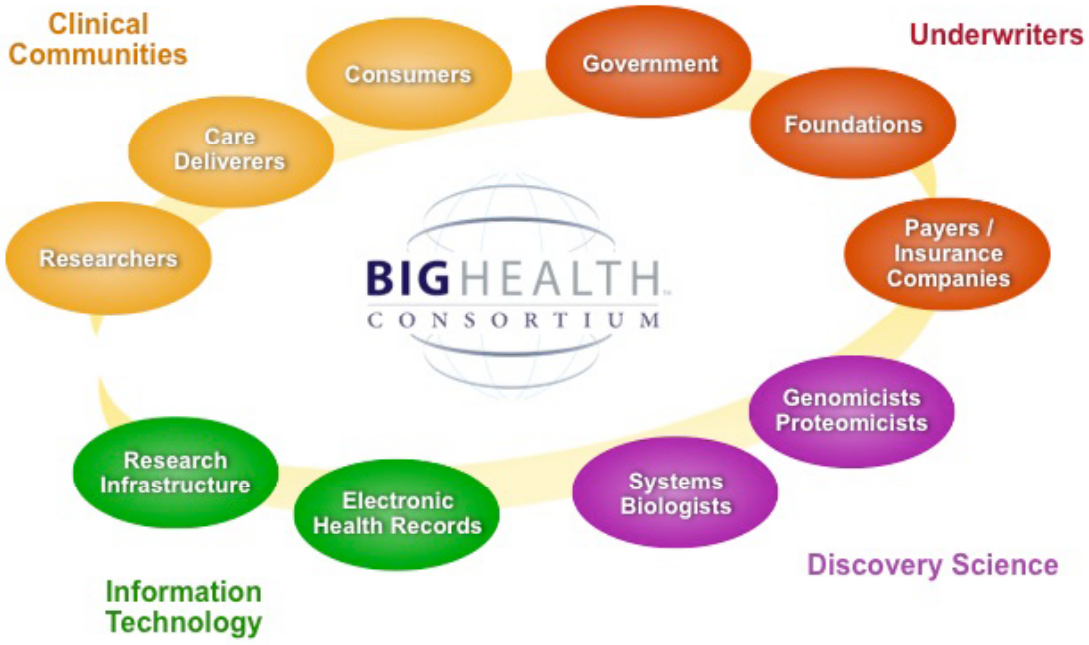
I-SPY Trial Process



21st Century Biomedical Ecosystem:The BIG Health

Consortium™

Building a Collaborative Ecosystem to Fuel the Knowledge Cloud



The Ecosystem at Work…
Research:

Participants
Patients join research networks, grant consent, agree to be "sought" and to enroll – "on-demand" participants

Biospecimen Collections
Researchers can access and query large collections of well-characterized, clinically annotated specimens

Discovery of Correlations
Biomarkers are identified and validated; disease sub-groups emerge

Individualization of Treatment
Patients are identified by sub-groups and
treated appropriately

The Ecosystem at Work…
Clinical Practice:

Electronic Health Records
EHRs can connect to clinical trials in
hospital settings

Research Finding Knowledgebases
Large-scale databases of latest research findings are connected to health delivery encounter

Learning Healthcare System
Local and national clinical encounter information is fed back to care providers to help inform clinical decision making

The Ecosystem at Work…
Consumer:

My Genomic Profile
Consumers get their genetic and predisposition
risk information

My Prevention Strategies
Consumers work with genetic counselors;
coordinate with health care provider

My Clinical Record
Consumers link to their clinical histories with genetic
profiles; access clinical research; participate in volunteer networks

The Ecosystem at Work…

Standards

Interoperability

Data Sharing

Connectivity

Sample BIG Health Projects

- On-line patient populations: Enabling 100's of thousands (millions?) of women to sign up on-line as a standing cohort for research
- Biorepositories: Enabling on-line access to biobanks of patient sub-groups (defined by disease, age, etc.)
- Patient Registries: Enabling on-line patient registries for longitudinal research
- Clinical Outcomes: Enabling access to clinical outcomes on large numbers of patients

- Clinical trial recruitment: Enabling access to patients within the NCI network (NCCCP)

In Summary…

- **A data-driven, collaborative approach to R&D can improve speed, efficiency and productivity**
- **NCI's 21st century ecosystem (BIG Health) encompasses**:
    - Community
    - Content
    - Connectivity platform
- **Biopharm companies can adopt the informatics platform to:**
    - Connect R&D internally
    - Collaborate with all other stakeholders in the biomedical community

caBIG®: Power of Connection

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