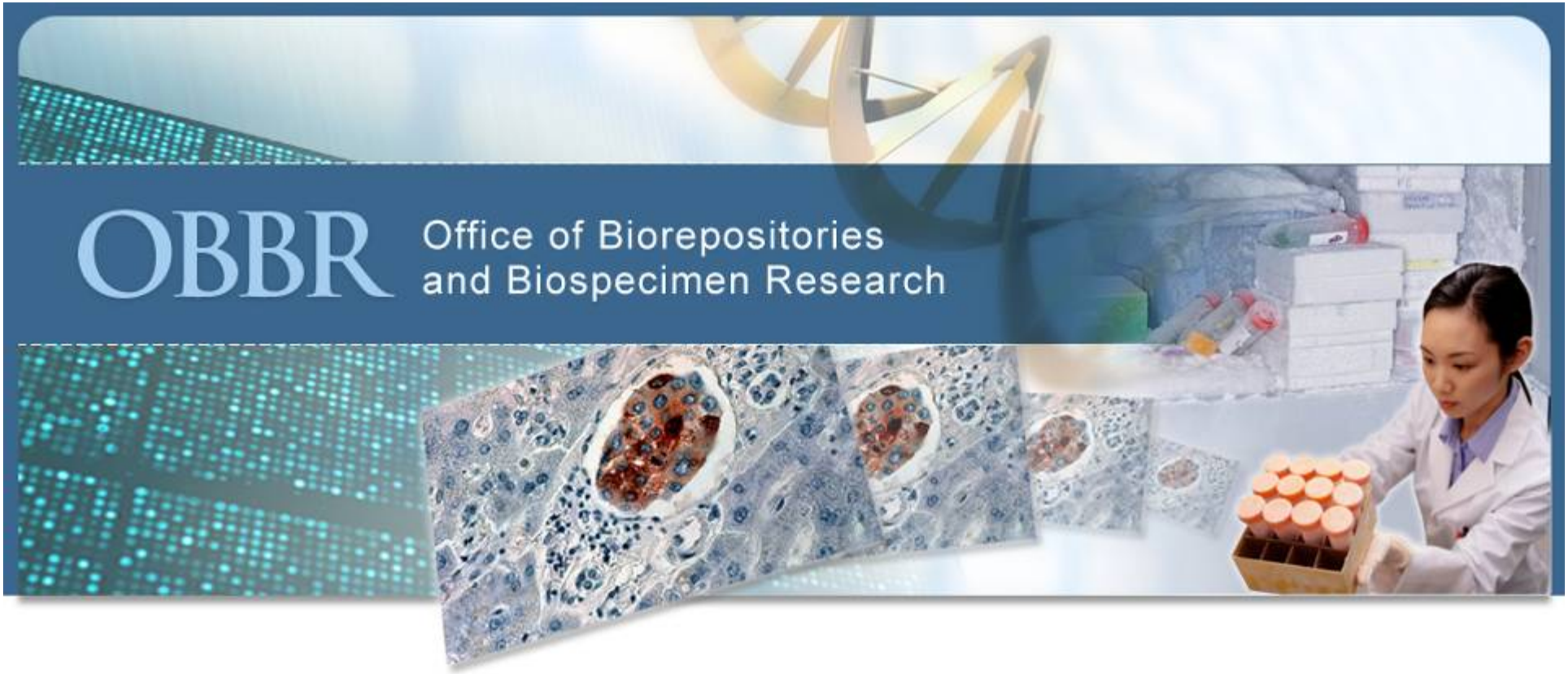

The Importance of High-Quality Biospecimens to the Research Enterprise: The Road to Molecular Medicine

Carolyn C. Compton, M.D., Ph.D.
Director, Office of Biorepositories and Biospecimen Research

NATIONAL CANCER INSTITUTE

Cancer: Our #1 Health Problem

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- **Cancer is the #1 killer of Americans under the age of 85**
- **1 American dies of cancer every minute**
- **Nearly 600,000 will die of cancer this year**
- **1.4 million will develop cancer this year**
- **1 of 3 females will develop cancer in their lifetime**
- **1 of 2 males will develop cancer in their lifetime**
- **$190 billion/year on healthcare costs for cancer alone**
- **NCI Budget = $4.8 billion/year**
  - advertising budget for cigarettes = $16 billion/year

A New Era: Molecular Technology Promises to Transform Oncology

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MOLECULAR MEDICINE

Beating cancer

Oct 14th 2004
From The Economist print edition

The war on cancer is entering a new phase

"CANCER" is one of those words that sends shivers down the spine. The phrase "battle with cancer" is a headline writer's cliché. And the military metaphor was widened in 1971, when Richard Nixon then president of the United States announced an initiative that later became known as the "war on cancer". Cancer, however, has not been beaten. Indeed, by some measures the problem is worse than it was three decades ago. It is true that treatments have improved somewhat, and prognoses with them, and that a few forms of the disease, particularly in children, can be cleared up altogether. But the biggest success has been due to people giving up smoking, rather than to new treatments. And despite that success, the likelihood that a person will get cancer at some point in his life has actually risen since Nixon's speech.

f the past three decades of effort have seemed a disappointment, the next ecade could prove to be one of rapid progress. The battle against cancer is at a rning-point. Because of recent advances, it is becoming possible to imagine a me in the not-too-distant future when new medical treatments will be able to me the disease, transforming it from a potent killer into something akin to a ronic complaint. The day when cancer no longer strikes terror in the heart of se diagnosed with it may not be far away (see article).

earchers have unravelled much of the basic molecular biology of cancer and, ed by the outpouring of knowledge that the Human Genome Project has ded over the past ten years, they have come to understand how the disease resses. Indeed, they have come to understand far more clearly than before the term "cancer" properly refers not to a single disease, but rather to a whole of diseases that have in common only the fact that they are caused by cells do not know when to stop dividing. That understanding has now reached the where it can be turned into action. The next few years should see an array of reatments that will add up to a big change in the way that cancer is viewed ealt with by society.

Evolution of Molecular Oncology

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Advances in Molecular Technologies and Research

The Past Century	21st Century
Established symptomatic disease	**Early detection and prevention**
Morphologic diagnosis and phenotypic tumor classification	**Molecular characterization of tumor pathways and processes**
Generic therapeutic regimens	**Targeted therapies**
Treatments have unpredictable adverse effects on patients	**Drug therapy based on host genetics that define response**

Understanding Specific Biology of Host and Disease

Translational Research Promises to Realize the Vision of Personalized Medicine

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Molecular Data

Diagnosis / Therapy

Translational Research

PERSONALIZED CANCER CARE

Biospecimen Analysis

Biospecimen Collection

Biospecimen Processing and Banking

The Road to Personalized Medicine

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- In the world of personalized medicine, the biospecimen is the center of the universe
  - Molecular characterization of the host
    - Disease susceptibility
    - Treatment efficacy (e.g., pharmacogenomics)
  - Molecular characterization of the disease
    - Molecular classification of tumor
    - Characterization of tumor heterogeneity / therapeutic targets

Molecular Research Using Human Analytes

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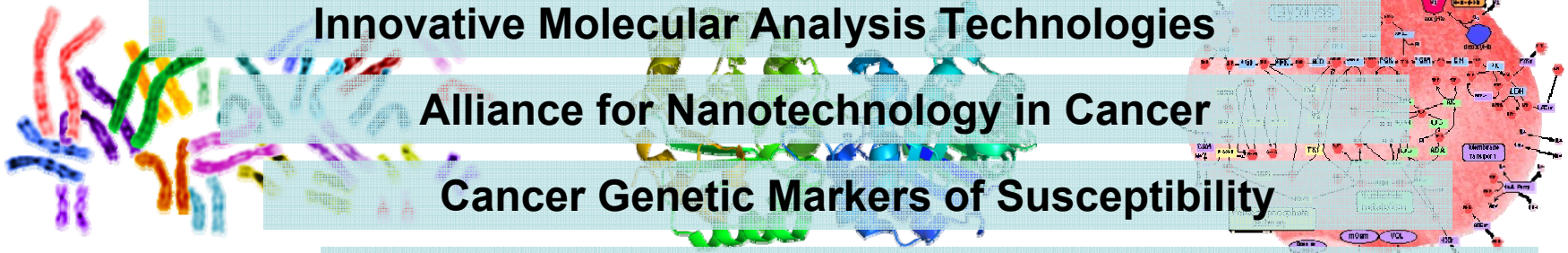
The Cancer Genome Atlas

National Community Cancer Centers Program

Genomics Proteomics Metabolomics

Clinical Proteomic Technologies Assessment for Cancer



Innovative Molecular Analysis Technologies

Alliance for Nanotechnology in Cancer

Cancer Genetic Markers of Susceptibility

Clinical trials correlative science

Molecular epidemiology programs

All Depend On High-Quality Human Biospecimens

SPORE programs

R01 Research

Technology Development and Today's Unprecedented Potential for Progress

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- **Technological change is exponential, not linear**
  - **"We won't experience 100 years of progress in the 21st century – it will be more like 20,000 years of progress (at today's rate)."**
    - **Ray Kurzweil, *The Law of Accelerating Returns***
- **Technology accelerates data production → knowledge**
- **Scientific knowledge will double in the next 3 years**
- **Biologic knowledge will double in the next 5 years**
- **The sum of all human knowledge is just 1% of what it will be in the year 2050**

Powerful Tools: Powerful Risks

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- We now have the technological capacity to produce low-quality data from low-quality analytes with unprecedented efficiency
- We can now get the wrong answers with unprecedented speed
- Unraveling the massive matrix of misleading data may compromise progress in unprecedented ways
- “The faster you go, the behinder you get”

The First Rule of Science

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GARBAGE IN → GARBAGE OUT

OBBR's Strategic Efforts: Taking Out the Garbage

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- Optimize and standardize the quality of human specimens for the research that will drive the development of personalized cancer medicine
- Remove the barriers to cancer research represented by the limited availability of high-quality, platform-appropriate human biospecimens
- Lay the foundation for tomorrow's standard of care

Systematic, Comprehensive Approach to Improving Biospecimen Quality

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- Develop state-of-the-science guidance for biobanking
  - NCI Best Practices for Biospecimen Resources
- Harmonize of biobanking practices across the NCI/NIH enterprise
  - **Group Banking Committee, TRWG, CCR, TCGA, CPTAC, Nanotechnology, NCCCP, IOTF, NCI-FDA-AACR Biomarkers Collaborative, et al.**
- Partner with accreditation and professional bodies to insure implementation and integration into the medical enterprise
- Facilitate the creation of a scientific evidence base for biospecimen procurement, processing, and stabilization that will enable the translational research leading to personalized cancer medicine

OBBR: Building Better Biospecimens

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Developing and implementing

state-of-the-science, data-driven processes that insure

the molecular integrity and clinical relevance

of human biospecimens

used in cancer research and clinical medicine

What is Biospecimen Science?

Understanding the Impact of Pre-analytical Variables on the Biological State / Molecular Composition Biospecimens

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Time 0

Specimen is viable and biologically reactive

Molecular composition subject to further alteration/degradation








Patient | Medical/ Surgical Procedures | Acquisition | Handling/ Processing | Storage | Distribution | Scientific Analysis | Knowledge Base

Pre-acquisition **Post-acquisition**

Variables for Study

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Pre-acquisition variables:

- Antibiotics
- Other drugs
- Type of anesthesia
- Duration of anesthesia
- Arterial clamp time
- Blood pressure variations
- Intra-op blood loss
- Intra-op blood administration
- Intra-op fluid administration
- Pre-existing medical conditions
- Patient gender

Post-acquisition variables:

- Time at room temperature
- Temperature of room
- Type of fixative
- Time in fixative
- Rate of freezing
- Size of aliquots
- Type of collection container
- Biomolecule extraction method
- Storage temperature
- Storage duration
- Storage in vacuum

The Potential Complexity of the Picture

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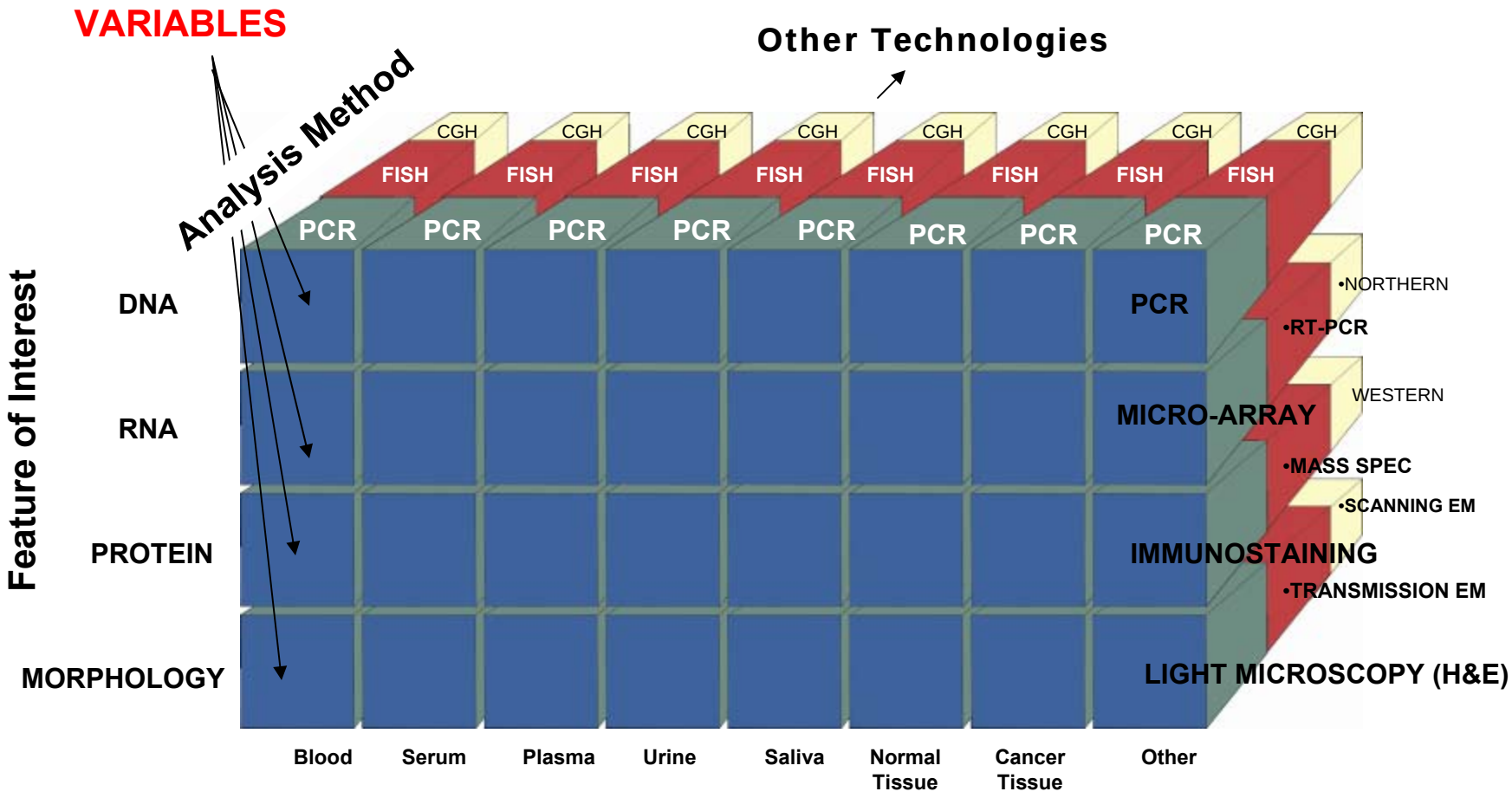

The Biospecimen as Object of Investigation

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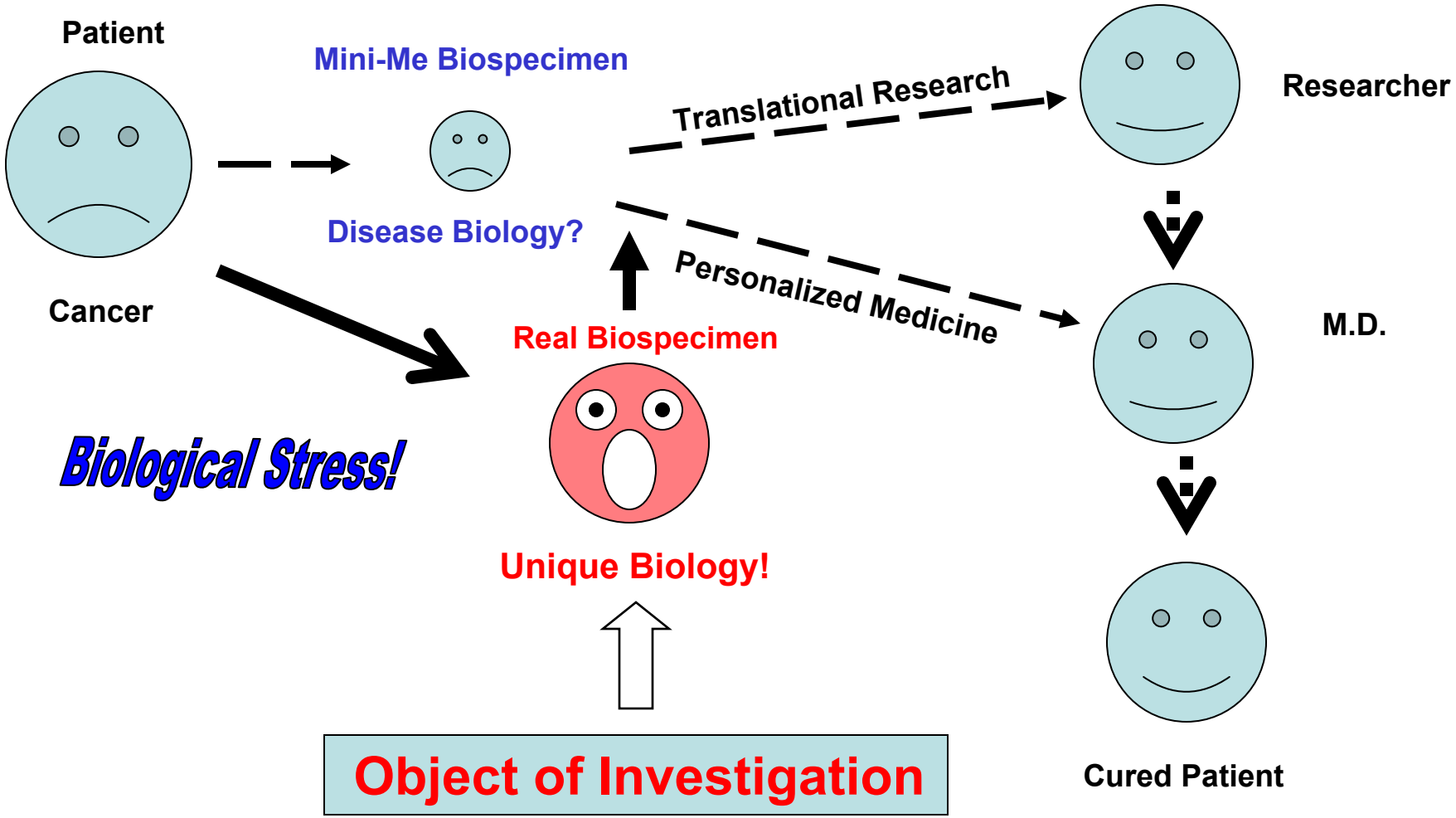

Changing the World….

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- **We are here to discuss, launch, and legitimize a new domain of scientific investigation**
  - Why it is critical
  - Why it is crucial to start now: what is at stake
  - Who's affected: the stakeholder's speak
  - How to begin and how to move forward
  - How to integrate this science into the fabric of medical practice

Time for Change

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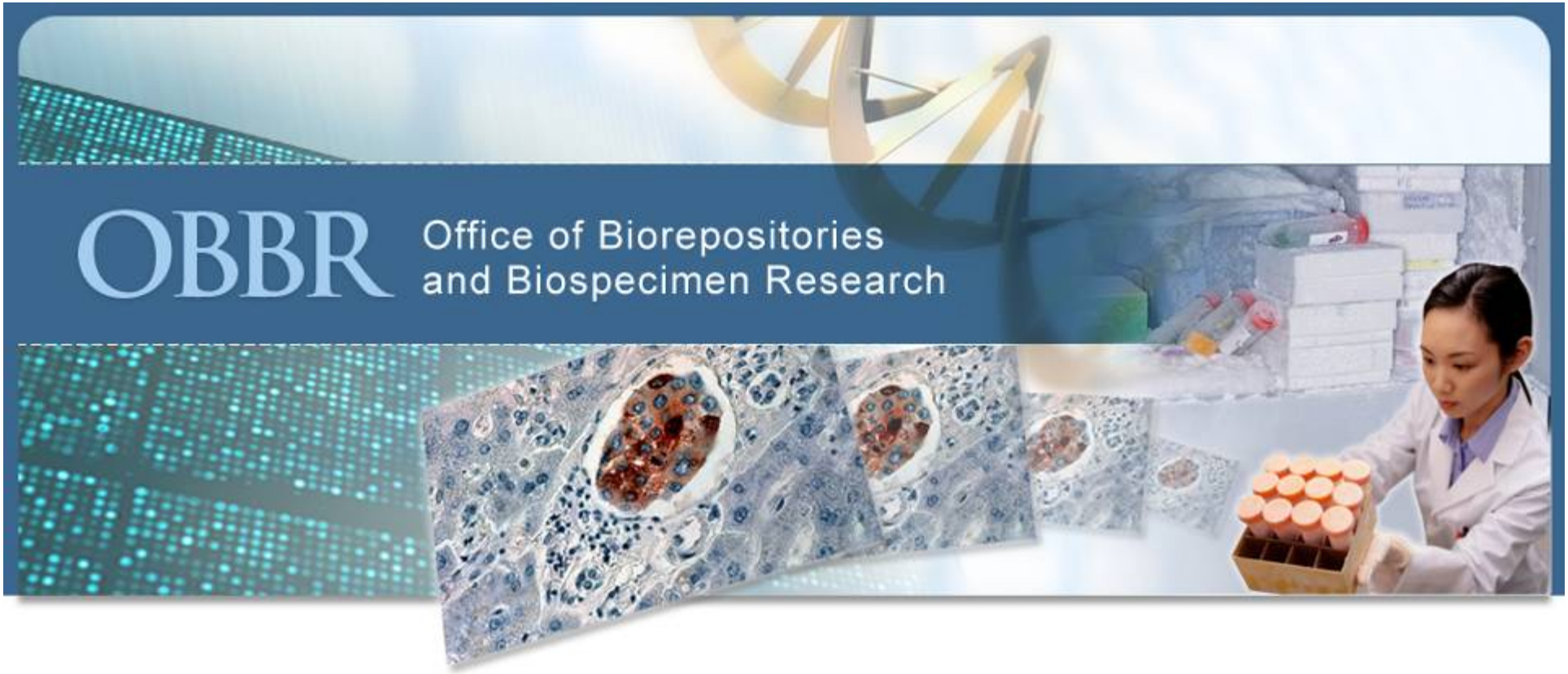
- "If you do what you've always done, you'll get what you've always gotten."

  - Anthony Robbins

- What we've got is no longer good enough to meet the needs of science, medicine, and technology - to serve patients

- Must enable the change that will change the world
  - Remove the single most significant obstacle to progress in translational research (and ultimately personalized medicine)



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