The NanoHealth Enterprise: Opportunity for Partnerships in Nanoscience Research Communities

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NIH mission

NIH is the steward of medical and behavioral research for the United States.

Science in pursuit of

- fundamental knowledge about the nature and behavior of living systems.
- application of that knowledge to prevent, detect, diagnose, and treat disease and disability.
Scope of Research

**Prevention Research**
- Exposure
- Routes of Exposure
- Biomarkers of Exposure
- Fate of Material on Entry

**Basic and Clinical Research**
- Cellular and Molecular Mechanisms
- Biomarkers of Disease/Progression
- Imaging and Sensor Technology
- Therapeutics

**Engineered Nanoscale Materials**
- Implications
- Applications
Nanotechnology Applications Research

Goal: Design materials, products or devices for a specific purpose or use

Approach: Manipulate size, shape, and chemistry to achieve desired outcome; maximize benefit and minimize risk
Nanotechnology Implications Research

Goal: Minimize adverse effect on human health and the environment

Approach: Understand how materials behave in biological systems
Conceptualizing the Science

Interaction of Engineered Nanomaterials with Biological Systems

Implications

Structure

Applications

Activity
Integrating Research Investments through Public-Private Partnerships

- Bring collaborative, entrepreneurial approach to large and complex problems and programs.
- Promote dialogue and coordinated effort across government, industry, and academia.
- Leverage scientific expertise and investment.
- Accelerate high priority projects by procuring services in new ways.
- Facilitate delivery of technology developed by private entities.
NIH: Organized for Partnership

Four Components for Success

– The Partners: science and resources
– Foundation for NIH: organizational structure
– Public Private Partnership Program: policy issues
– Office of General Council: legal issues
Model 1: Private Funds to FNIH Pooled with NIH Funding

PRIVATE PARTNERS → FOUNDATION FOR NIH → NIH → GRANTS or CONTRACTS

STEERING COMMITTEE/SCIENTIFIC BOARD

Examples:
- Osteoarthritis Initiative
- Overcoming Barriers to Early Phase Clinical Trials
- Alzheimer’s Disease Neuroimaging Initiative
- Imaging Database Resources Initiative

$: Flow

Information Flow

Scientific Direction
Model 2: Parallel Funding Mechanism, Supplementing NIH’s Efforts

- NIH
- PRIVATE PARTNERS
- STEERING COMMITTEE/SCIENTIFIC BOARD
- FOUNDATION FOR NIH

Examples:
- Mouse Sequencing Consortium

- $ Flow
- Information Flow
- Scientific Direction
Building the NanoHealth Enterprise

- Build on the NIH investment and expertise
- Invite stakeholder participation
- Target questions within a shared research strategy
- Harmonize with US goals for commercialization and innovation

Diagram:
- Material Synthesis
- Environmental Exposure
- External Contact
- Internal Dose
- Biological Response
- Early Markers of Disease
- Clinical Disease

Susceptible Populations

The National Nanotechnology Initiative

Environmental, Health, and Safety Research Needs for Engineered Nanoscale Materials
Conceptualizing Shared Research interests

Interaction of Engineered Nanomaterials with Biological Systems

Implications

Applications

Structure

Activity

Computational Models for Safe Design

High Throughput Screening
Trends in NanoBio Interactions

- Renal Clearance
- Biliary Clearance?
- Cytotoxicity (Surface Reactivity)
- RES Recognition (EPR Effect)
- Size (Rigid Core)
- Solubility
- Zeta Potential (+) Low, (-) High
- Cytotoxicity Dose (mg/mL)

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Expanding the Definition of Research Products

- Biologically and clinically relevant design principles
- Curated data sharing framework
- Network of research partners
- Strategic product design and development
- Shorter time from concept to manufacture
- Data for hazard identification
- Standards setting

Expanding the Definition of Research Products
Targeted Research Projects

Interaction with Biological Fluids

Dose Metrics
Uptake by Route of Exposure
Interaction with Biological Fluids

Informatics Resource

Implications

Applications

Interaction of Engineered Nanomaterials with Biological Systems
Exploratory Research Programs

Interaction of Engineered Nanomaterials with Biological Systems

Implications

Applications

Uptake by Route of Exposure

Interaction with Biological Molecules

Inflammation Immunity

Exacerbation of Existing Disease

Informatics Resource
Parallel Paths within the NHE

Interaction of Engineered Nanomaterials with Biological Systems

Implications

NHE Working Groups

Informatics Resource

Applications

Industrial/Academic Projects
Building the NanoHealth Enterprise

Governance Structure

- Project 1
- Project 2
- Project 3
- Project 4
- Project 5

Review

Research Awards
Building the NanoHealth Enterprise

Harness the Power of Nanotechnology

Enable Discovery

Principles of Safe Design