Emerging Technology Programs at FDA
A Case Study in Nanotechnology

October 24, 2012
Georgetown University

U.S. Food and Drug Administration
Advancing Regulatory Science

Outline

Why should FDA focus on Emerging Technologies

FDA Organization/Office of the Chief Scientist

Strategic Plan for Regulatory Science

A Case Study: FDA's Approach to Nanotechnology

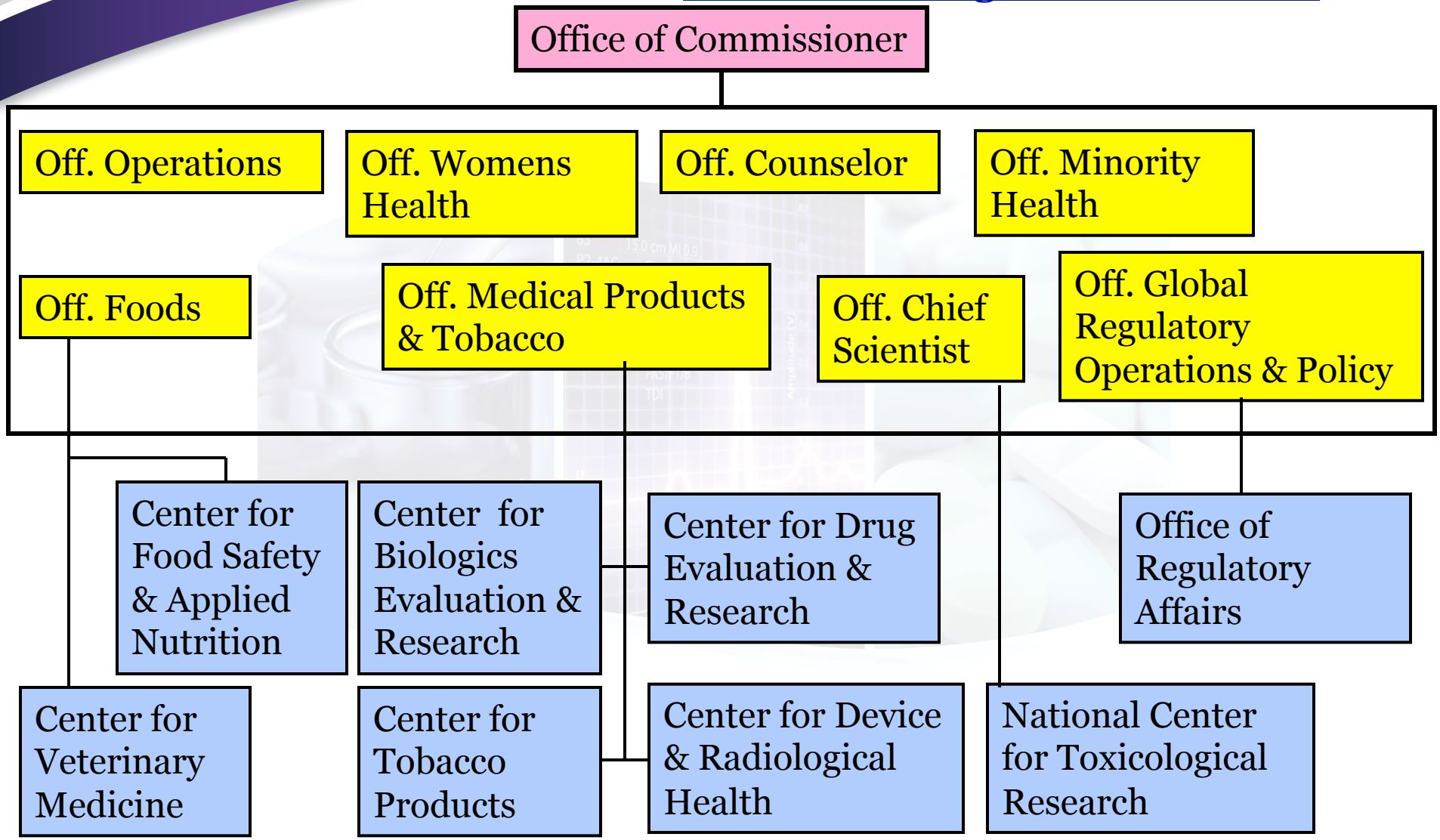
Detailed Review of FDA's Regulatory Science Programmatic Investment Areas

Wrap Up

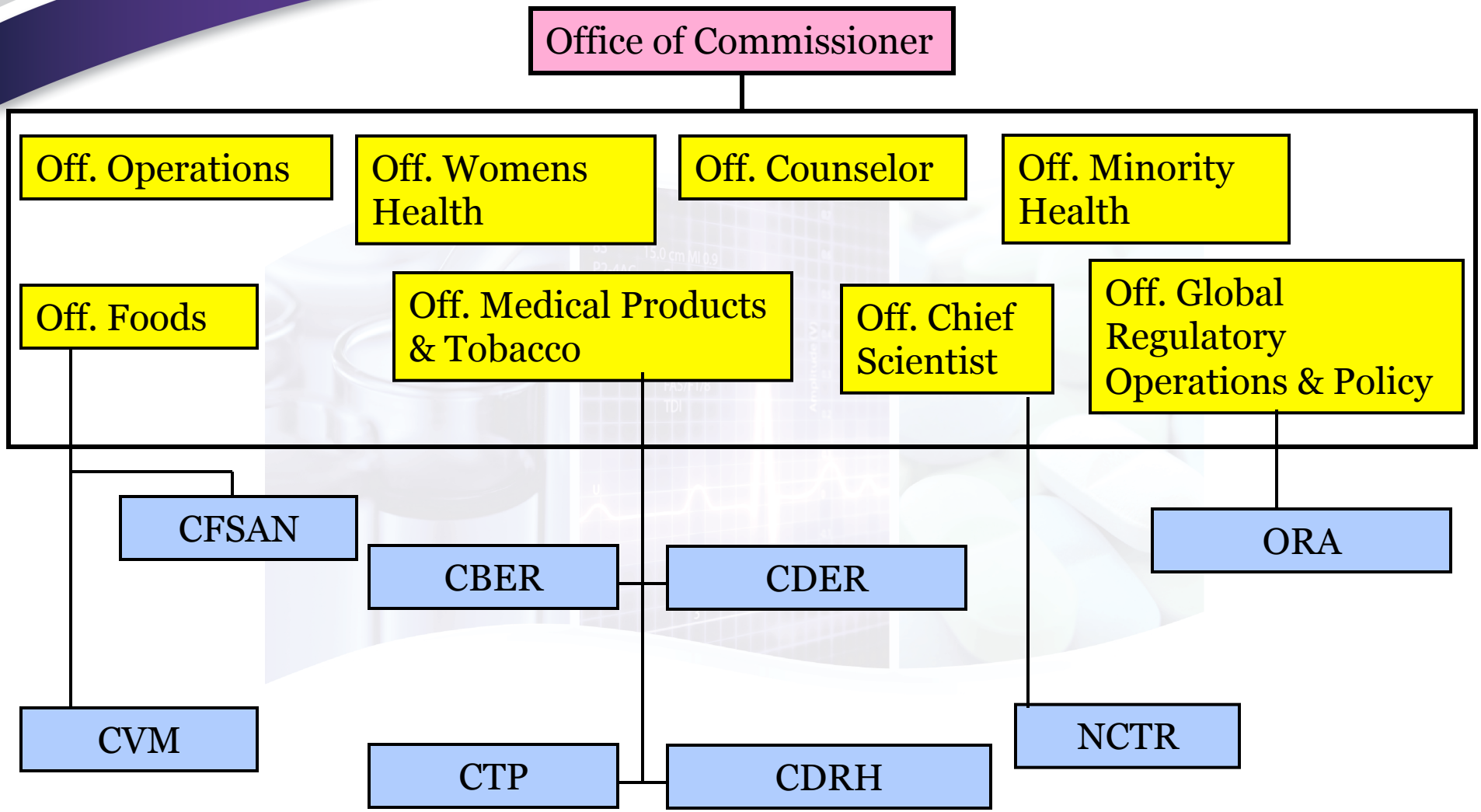
Why Should FDA Focus on Emerging Technologies?

- Emerging Technologies can represent a significant advance across one or more FDA regulated product areas.
- For medical products, emerging technologies can potentially offer:
  - improved treatments
  - better prognosis
  - reduced recovery times
- Innovative, emerging technologies can also involve risk and uncertainty.

Food and Drug Administration



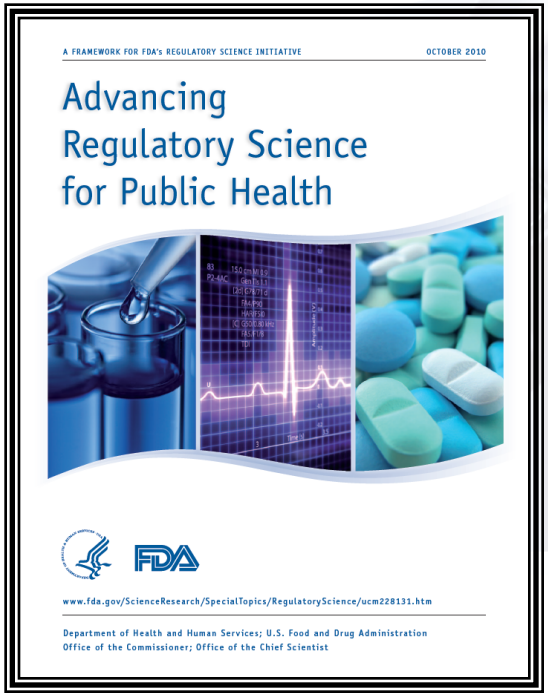
Food and Drug Administration

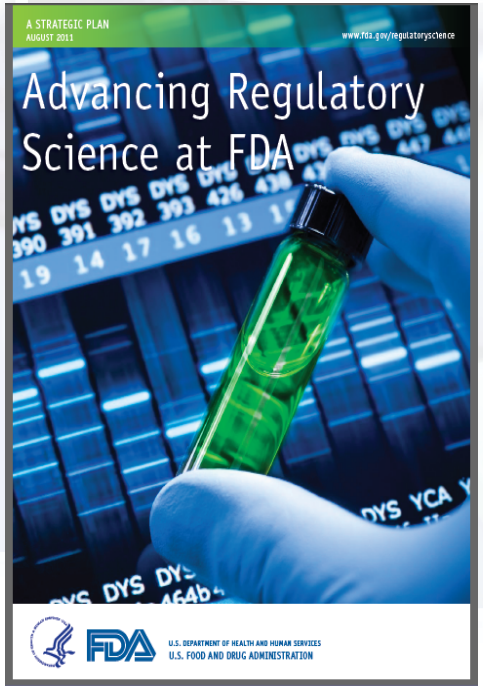


Office of the Chief Scientist

- Provide cross-center scientific coordination
- Provide strategic leadership and support for high quality, collaborative, scientific activities that advance regulatory science and address important public health issues concerning FDA regulated products, including their evaluation, quality, safety and effectiveness
- Lead agency efforts to protect and enhance scientific integrity, and, where substantive scientific differences of opinion arise and require review at the FDA level, addressing them through appropriate processes intended to protect both FDA's mission and the integrity of its science

Regulatory Science Publications





What is Regulatory Science?

- The application of basic science to the development and utilization of new tools, standards, and approaches for the assessment of medical product efficacy, safety, and quality
- The critical bridge between basic scientific research discoveries and new marketed products

Regulatory science at FDA: Pillars in Implementation

- Leadership, coordination, strategic planning and transparency to support science and innovation
- Support for scientific excellence, professional development and a learning organization
- Support for mission-critical applied research, both at FDA and collaboratively
- Recruitment and retention of outstanding scientists

Strategic Plan-Purpose

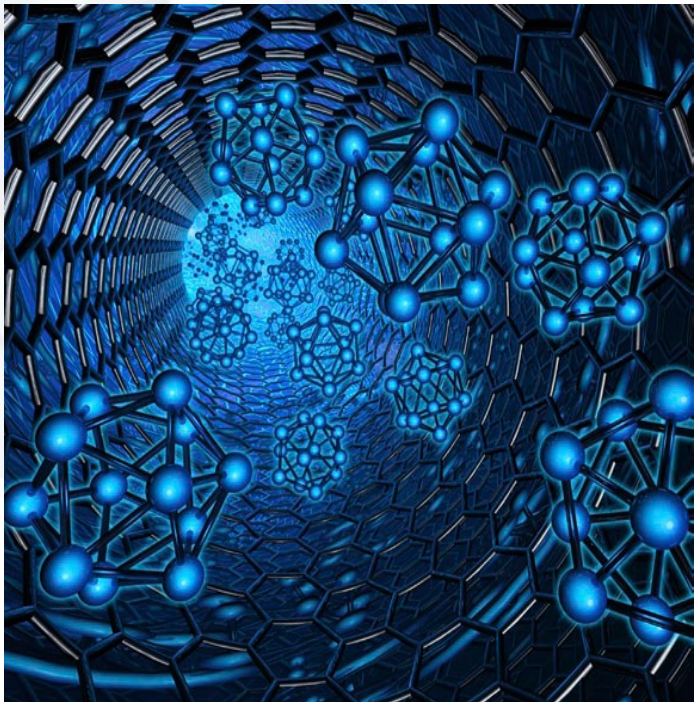
- Identify opportunity areas of regulatory science essential to the success of FDA's public health mission
- Develop/use the 21st century regulatory science tools and approaches for evaluation of 21st century products
- Promote innovation through targeted and collaborative approaches to regulatory science that enable new technologies and product development
- Build FDA's scientific capacity, infrastructure, culture and collaborations, including through scientific and professional development of FDA's scientists

Eight (8) Priority Areas

- Modernize Toxicology to Enhance Safety
- Stimulate Innovation in Clinical Evaluation & Personalized Medicine
- Support new Approaches to Improve Product Manufacturing and Quality
- Ensure FDA Readiness for Emerging Technologies
- Harness Diverse Data through Information Sciences to Improve Health Outcomes
- Enable a Prevention Focused Food Safety System
- Facilitate Development of Medical Counter Measures to Protect US and Global Health and Security
- Strengthen Social and Behavioral Science to Help Consumers, Professionals Make Informed Decisions

Priority Area 4.
Ensure FDA Readiness to Evaluate Innovative Emerging Technologies

- Stimulate development of innovative medical products while concurrently developing novel assessment tools and methodologies
- Develop assessment tools for novel therapies
- Assure safe and effective medical innovation
- Coordinate regulatory science for emerging technology product areas



A Few Topic Areas[1]

Systems Biology
Wireless Health Care Devices
Robotics
Nanotechnology
Medical Imaging
Cell and Tissue Based Therapy
Regenerative Medicine
Combination Products

1. FDA Mission at Risk Science Board Report, 2007

Priority Area 4: Case Study-Nanotechnology

- Evolving state of science on biological interactions and methodologies for assessing safety, effectiveness, performance, and product quality
- Different applications and routes of exposure
- High degree of interest among academia, industry, and trade stakeholders
- Regulatory approaches continue to evolve within federal agencies and international counterparts

Why should FDA focus on Nano?

National Nanotechnology Initiative

Drug Delivery Systems

Food Applications

NNI Signature Initiatives

Veterinary Medicine

Medical Devices

Dietary Supplements

Nanotechnology-enabled Products

Sunscreens

Cosmetics

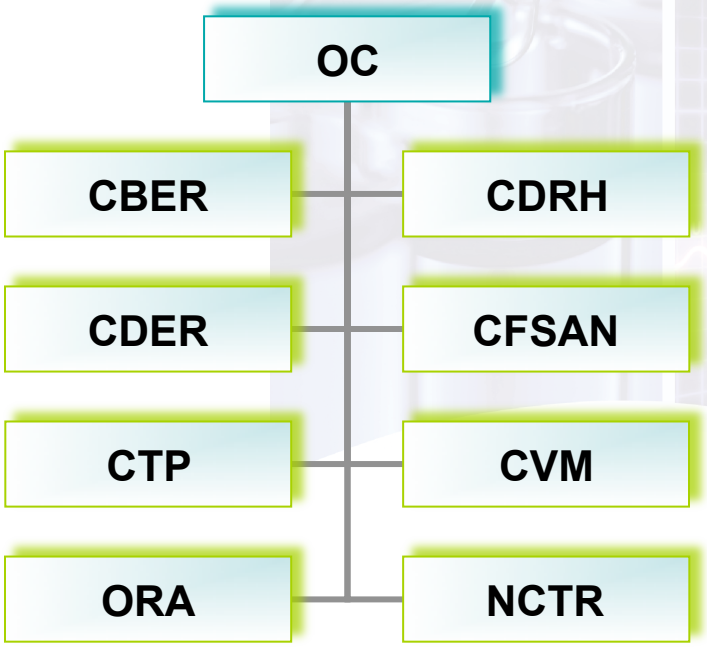
Wound Dressings

Why Do We Need Regulatory Science?

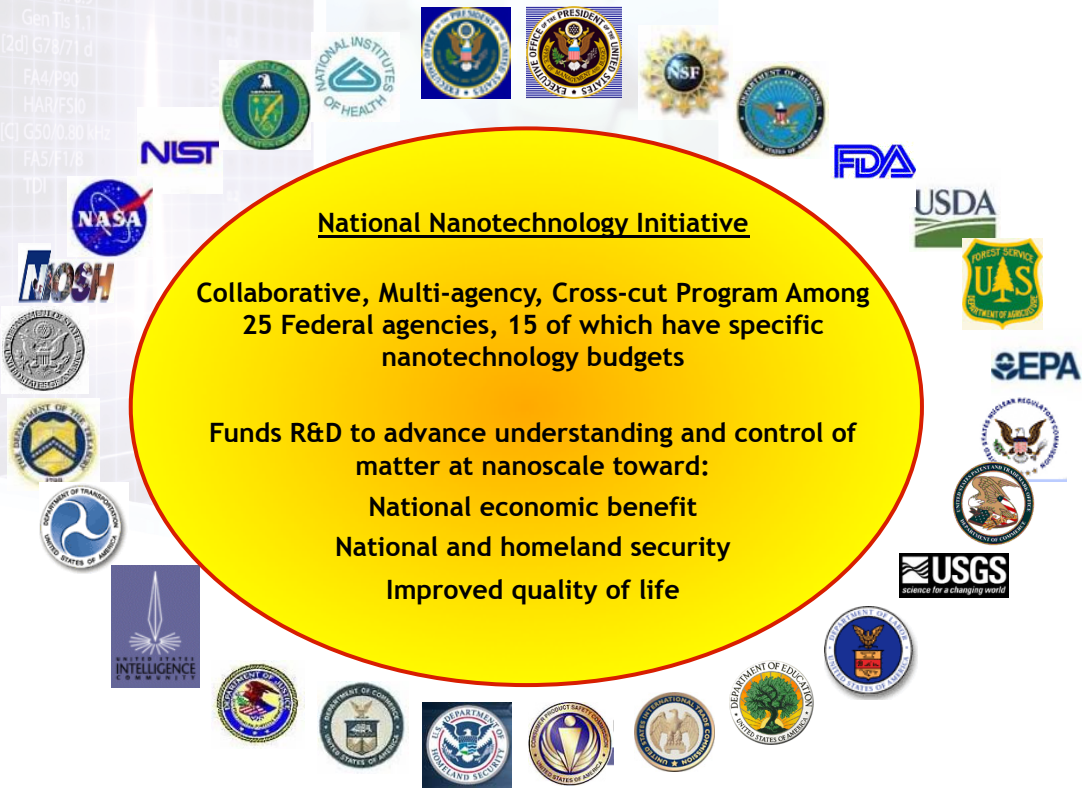
- Enable major investments and advances in basic sciences to translate faster into products to benefit consumers
- Protect consumers by applying best possible science to support regulatory activities and decision-making
  - Pre-market review
  - Post-market surveillance
- Keep pace with and fully utilize advances in innovation, while also facilitating development of innovative products that benefit consumers and patients

Nanotechnology Coordination

Internal – Nanotechnology Task Force



External (United States Government) – National Nanotechnology Initiative



FDA's Nanotechnology Regulatory Science Plan

http://www.fda.gov/ScienceResearch/SpecialTopics/Nanotechnology/default.htm

Program Management

- Program Administration
- Tracking Projects
- Coordination
- Oversight

Strategic Partnerships

- Domestic
- International

FDA's Regulatory Science Approach to Nanotechnology

FDA Programmatic Investment Area	2011	2012	2013	Program
FDA Staff Training	X	X	X	Center Workshops
	X	X	X	Introduction to Nanotechnology online
		X	X	Applied Courses in Nanotechnology online
		(pilot)	X	Hands On Laboratory Course
			X	*Ad hoc* Topic Specific/Product Relevant Review Courses
			X	External Training Opportunities
			X	FDA Nanotechnology Regulatory Science Research Workshop
FDA Core Facilities	X	X	X	Center Specific Laboratories
	X	X	X	NCTR Core Facility
		X	X	White Oak Core Facility
		X	X	FDA Coordination Plan (Safety, Toxicology, Characterization, Manufacturing)
			X	Public Private Partnerships with External Stakeholders
			X	Joint funding Laboratory Facility Projects
FDA Intramural Regulatory Science Research (CORES)	X	X	X	Center Specific Projects
	X	X	X	CORES Program
		X	X	External Peer-Review
			X	Engage Domestic & International Research Opportunities
			X	Additional Product Specific Regulatory Science Research

Staff Training and Professional Development

Target Audiences

Staff with different needs

- Review Staff
- Research Staff
- Field Staff
- Regulatory Policy Staff

Equipment Core Facilities Use/Outcomes

- Support the conduct of research to establish methods for use by Agency scientists (e.g. quantification of nanomaterial ionization in vitro and in vivo);
- Provide equipment and expertise to conduct specific measurements or assays for FDA scientists;
- Provide within-Agency expertise for confidential consultations regarding nanomaterial characterization or quantification;
- Provide equipment and expertise to train Agency scientists on measurement techniques for nanomaterials (“hands-on”);
- Maintain equipment for use by Agency scientists on projects; and
- Augment other existing equipment at each Center.

FDA's Nanotechnology CORES Program

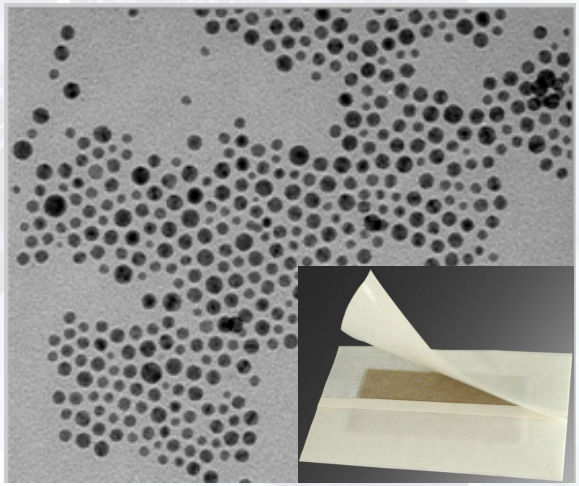
Collaborative **O**pportunities for **R**esearch **E**xcellence in **S**cience

- Physico-chemical characterization in FDA-regulated products
- Nonclinical modeling of nanomaterials in FDA-regulated products
- Risk characterization information
- Risk assessment
- Risk communication

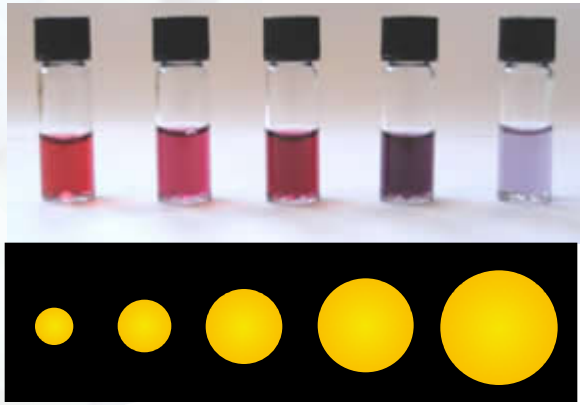
Coordinating Regulatory Science in Nanotechnology

Nano TiO_2 / Nano ZnO

Nanosilver

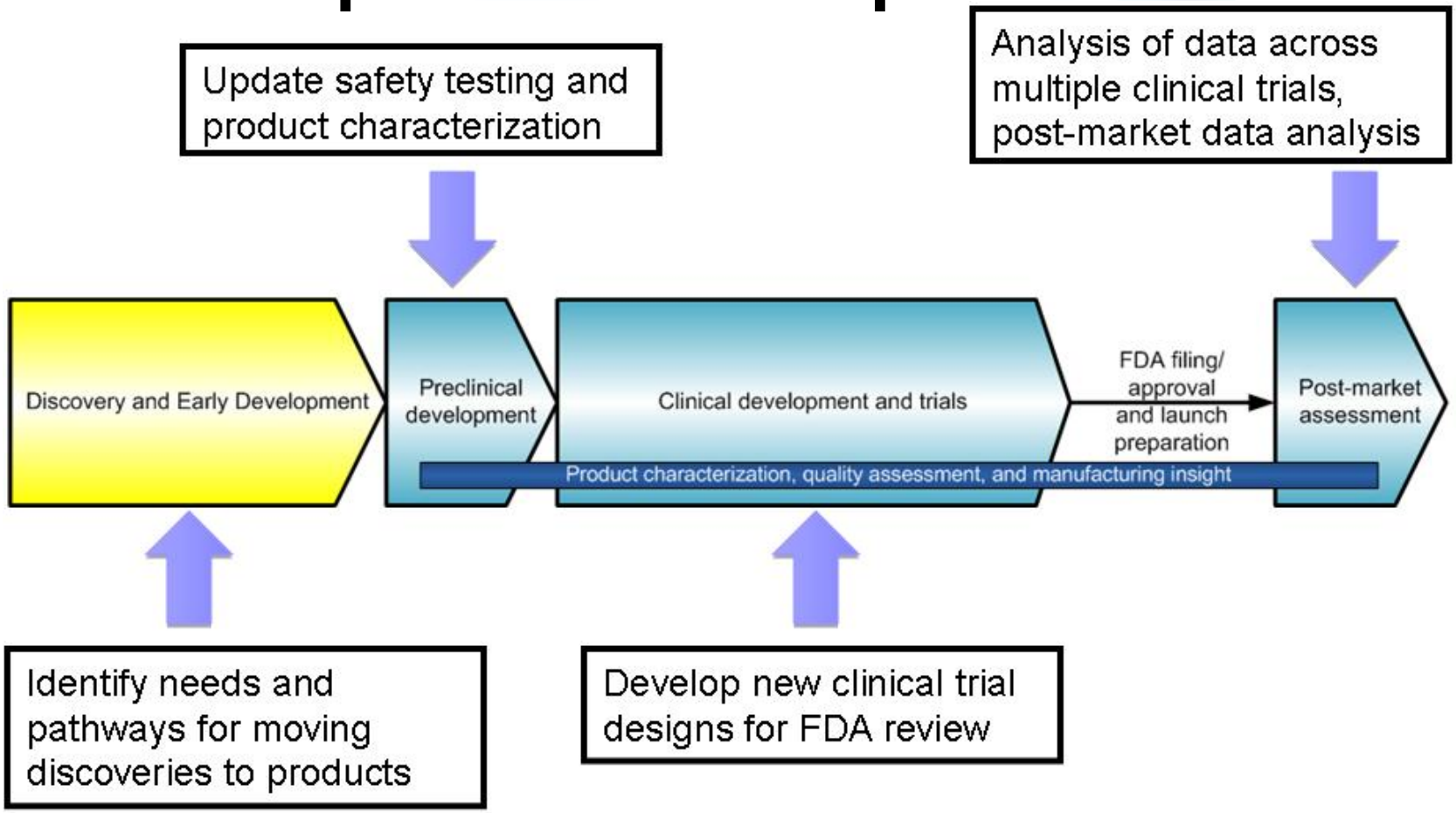


Nanogold



Connect labs using similar:
1) methods; 2) materials; 3) applications; or 4) research categories

Where does Regulatory Science fit into product development?



Additional Activities

U.S. Department of Health & Human Services

U.S. Food and Drug Administration
Protecting and Promoting *Your* Health

A to Z Index | Follow FDA | FDA Voice Blog

SEARCH

Most Popular Searches

Home | Food | Drugs | Medical Devices | Vaccines, Blood & Biologics | Animal & Veterinary | Cosmetics | Radiation-Emitting Products | Tobacco Products

Science & Research

Home › Science & Research › Science and Research Special Topics › Nanotechnology

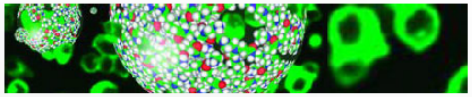
Science and Research Special Topics

- Nanotechnology
- Current Nanotechnology Programs at FDA

Resources for You

- FDA Nanotechnology Regulatory Science Research Categories
- FDA Publications

Nanotechnology



The U.S. Food and Drug Administration (FDA) regulates a wide range of products, including foods, cosmetics, drugs, devices, veterinary products, and tobacco products some of which may utilize nanotechnology or contain nanomaterials. Nanotechnology allows scientists to create, explore, and manipulate materials measured in nanometers (billionths of a meter). Such materials can have chemical, physical, and biological properties that differ from those of their larger counterparts.

FDA Guidance on Nanotechnology

- Nanotechnology Fact Sheet
- New - FDA issues two draft guidances related to nanotechnology applications in cosmetics and food substances
- Draft Guidance for Industry: Considering Whether an FDA-Regulated Product Involves the Application of Nanotechnology

FDA Activities

- Nanotechnology Task Force
- Nanotechnology Task Force Report 2007

Spotlight

- FDA Continues Dialogue on 'Nano' Regulation
- FDA's Approach to Regulation of Nanotechnology Products
- Article by FDA Commissioner Magaret A. Hamburg in Science, April 2012
- Nanotechnology Regulatory Science Research Plan

Related Links

- Public Engagement
- National Activities
- International Activities
- Nanotechnology Partnerships at FDA
- FDA Response to Citizen Petition filed by International Center for Technology Assessment et al. (2012)

POLICYFORUM

SCIENCE AND REGULATION

FDA's Approach to Regulation of Products of Nanotechnology

A broadly inclusive initial approach may become more nuanced in light of experience, scientific information, and public input.

Margaret A. Hamburg

The U.S. Food and Drug Administration (FDA) has long encountered the combination of promise, risk, and uncertainty that accompanies new technologies. This is equally true for nanotechnology, which engenders both excitement and concern owing to the rapidly evolving science and range of applications. The very changes in biological, chemical, and other properties that make some applications so exciting may also present new questions about how to predict, identify, measure, and monitor possibly harmful effects.

FDA is generally responsible for overseeing the safety and effectiveness of drugs and devices for humans and animals and of biological products for humans, and the safety of foods (including food additives and dietary supplements), color additives, and cosmetics. The agency conducts these oversight functions under a variety of laws and regulations, which establish the specific premarket and/or postmarket oversight mechanisms applicable to a particular class of products (*1*). We focus below on identifying FDA products that involve nanotechnology, evaluating products that contain nanomaterials, and ensuring a responsive regulatory framework, which may be tailored to specific product areas overtime.

Identifying Nanomaterials for Regulation

FDA's regulatory science priorities are focused on issues relevant to oversight of products subject to its regulations. Identifying nanomaterials is an important first step. Materials can exhibit new physicochemical properties at nanoscale dimensions (*2*), and properties that are attributable to size can be seen or retained even when the material or end-product may not necessarily exist entirely within the nanoscale (*3*–*7*). Although one definition for "nanomaterial" may offer meaningful guidance in one context, that definition may be too narrow or broad in another. For this reason, FDA is not at this time adopting a regulatory definition of nanotechnology. Instead, it is initially taking a broadly inclusive approach to considering whether FDA-regulated products contain nanomaterials or involve nanotechnology.

FDA recently issued a draft guidance for industry on this topic (*8*) proposing that when evaluating whether an FDA-regulated product contains nanomaterials or involves nanotechnology, FDA and its stakeholders should consider the following: Does an engineered material or end-product have at least one dimension in the nanoscale range (~1 to 100 nm)?; or does it exhibit properties or phenomena, including physical or chemical properties or biological effects, that are attributable to its dimensions, even if these dimensions fall outside the nanoscale range, up to 1 μm? Structures such as agglomerates and aggregates are of interest in this context (*3*), as are coated, functionalized, or hierarchically assembled structures (*4*). This initial broadly inclusive approach may become more nuanced in light of experience, available scientific information (including the agency's own regulatory science research), and public input, which will inform any future agency issuance of regulatory documents or public communication efforts. There may also be an opportunity to pursue approaches specifically tailored to FDA's various product areas.

Until then, industry and developers should keep both of these broad size- and property-related factors in mind when considering whether their products might fall within FDA's attention for nanomaterials and are encouraged to consult with the agency early in their development process to resolve any uncertainties.

Evaluating Products Containing Nanomaterials

Whether a product is subject to premarket review (e.g., new drugs, biological products, certain devices, and food and color additives) or not (e.g., cosmetics), industry is required to ensure that the product satisfies applicable safety standards and complies with other applicable requirements. Substantiation of safety requires scientific evidence. The FDA Nanotechnology Task Force made recommendations for a staged approach to determining whether current tests are adequate to support risk management decisions and where they are not, to collect data and update procedures (*9*). Of particular importance are the following:

- routes of exposure, including inhalation, dermal absorption, and ingestion (e.g., as related to cosmetics and foods), as well as exposure media (e.g., air, water, and food).
- properties related to absorption, distribution, metabolism, and excretion (ADME) (e.g., as related to drugs). Because biological interactions may be influenced by size changes, this may require additional analytical techniques capable of determining physical characteristics (e.g., size or aggregation) not previously assessed for tissue samples collected in ADME studies.
- size, size distribution, surface charge, surface properties, particle interactions, particle behavior, purity, stability, and general batch-to-batch variability. The new properties of materials and products that involve nanomaterials or applications of nanotechnology may require additional product-specific testing and manufacturing controls.

For FDA, regulatory science addresses these questions and involves developing new tools, standards, and approaches to assess the safety, efficacy, quality, and performance of FDA-regulated products, to help evaluate whether products are appropriate for marketing (*10*). FDA plans to continue to invest in a regulatory science program that includes such areas as nanomaterial characterization, in vitro and in vivo modeling, and product-focused research. There may be areas of application that deserve special attention, such as cosmetics, for which there is no premarket review that requires industry to provide the agency with product-specific data. For these products, better characterization of nanotechnology-based products—as well as the development and evaluation of models for predicting safety, effectiveness, and quality—will help industry fulfill their responsibility to ensure product safety before marketing and will help FDA in its postmarket surveillance. There may also be product-specific research needs in areas such as novel medical products for serious diseases. FDA is sharing information, coordinating its activities, and combining resources through interactions with other U.S. agencies, such as through the interagency National Nanotechnology Initiative (*11*). FDA is also participating in pub-

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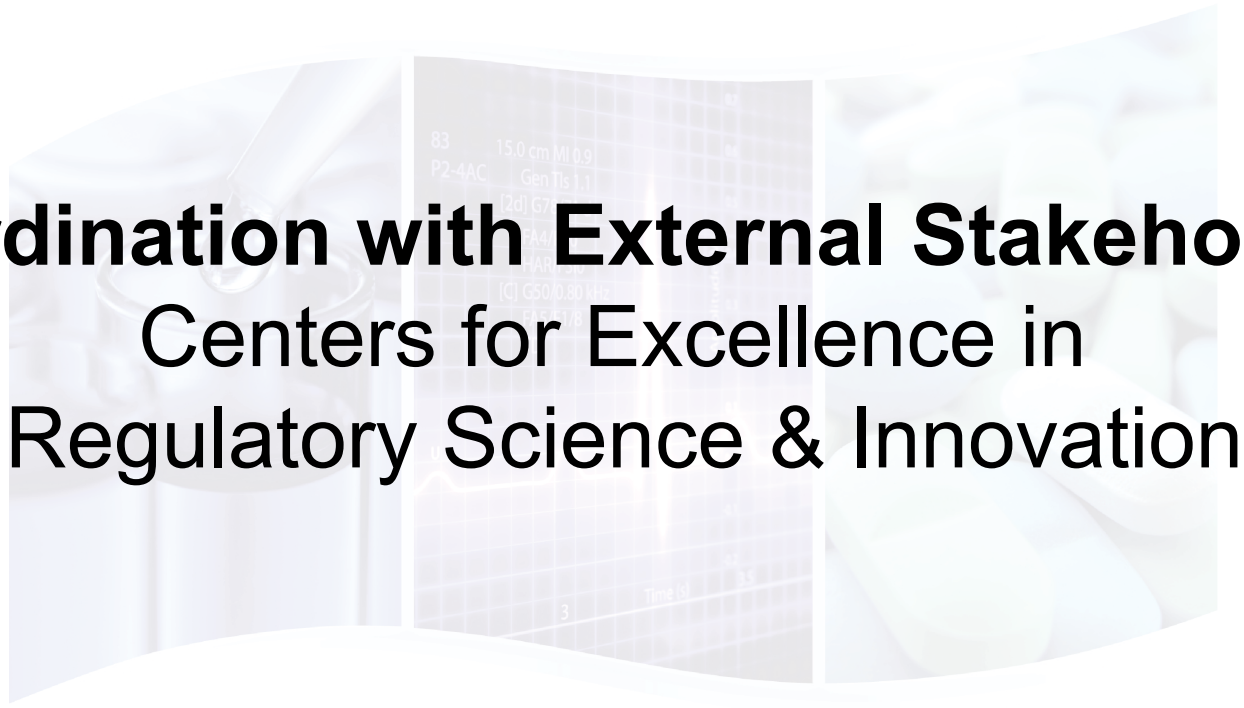
Published by AAAS

FDA Approach to Nanotechnology

- Science
- Regulatory Research
- Staff Training & Professional Development
- Policy
- Communication



Coordination with External Stakeholders

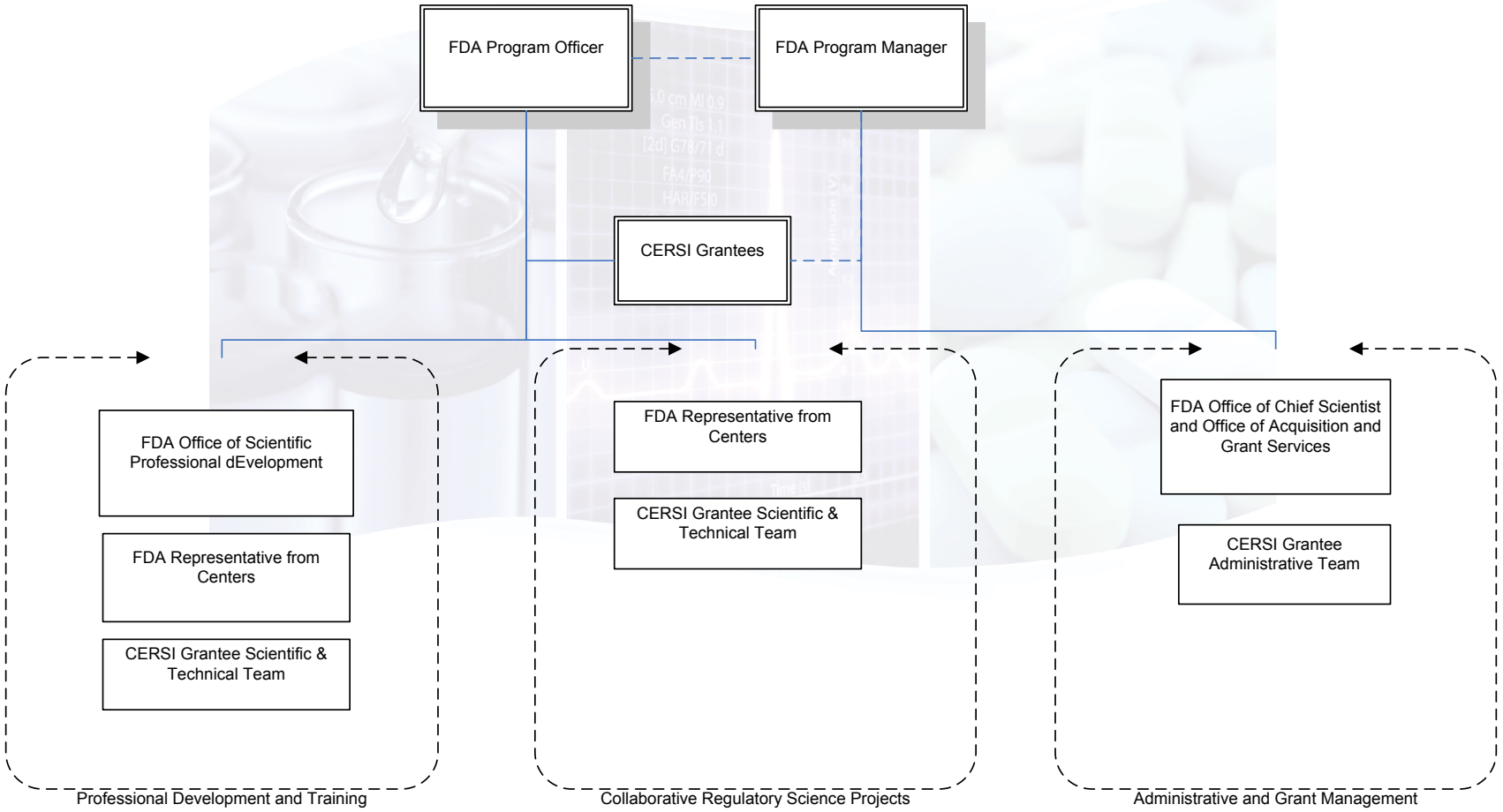
Centers for Excellence in Regulatory Science & Innovation

Centers of Excellence in Regulatory Science and Innovation

- FDA funded 2 awards / 3 years (depending upon availability of funds)
- Three Main Components:
  - Regulatory science collaborative research, focused on FDA Priority areas
  - Staff training and scientific exchange (bi-directional)
  - Core dedicated infrastructure to support the above
- FDA's Collaborating Centers of Excellence in Regulatory Science and Innovation (CERSI) Cooperative Agreement RFA awarded to Georgetown University and University of Maryland

Building New Partnerships

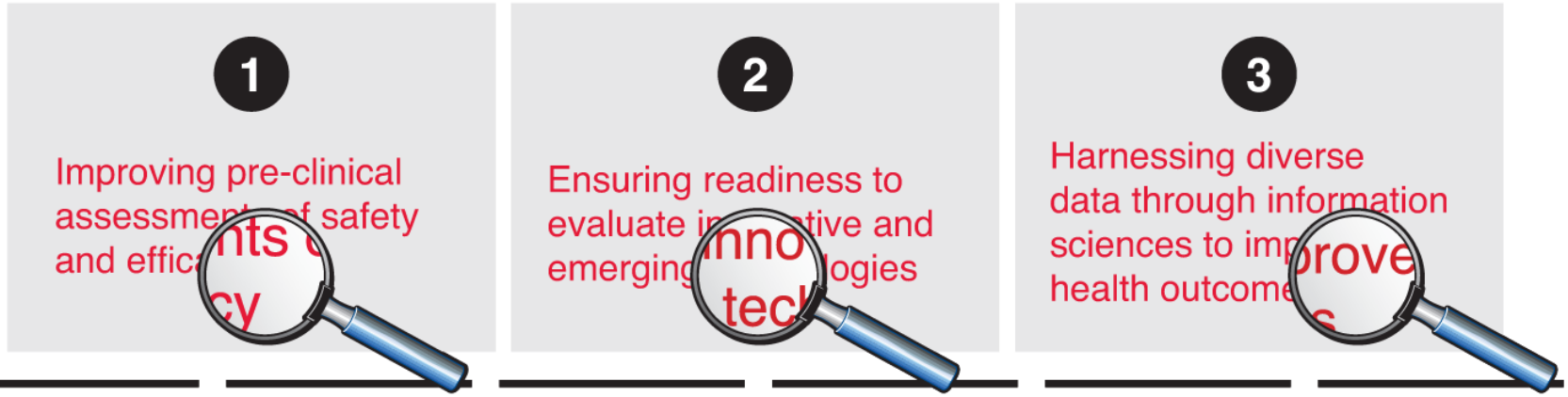
Centers for Excellence in Regulatory Science and Innovation



Centers for Excellence

Current Work & Next Steps

- Established FDA Staff Working Groups and Scientific Steering Committee
- Identified regulatory science research milestones
- Building staff training and professional development opportunities
- Conducting site visits (biannually)
- Engage and seek guidance from the FDA Staff, Science Board, External stakeholders
- Continue to evaluate outcomes



Improving pre-clinical assessments of safety and efficacy

Improving clinical studies and evaluation

Supporting new approaches to improving product manufacturing and quality

Ensuring readiness to evaluate innovative and emerging technologies

Harnessing diverse data through information sciences to improve health outcomes

Strengthening social and behavioral science to help consumers and professionals make informed decisions about FDA regulated products

COLLEGE PARK CAMPUS

UNIVERSITY OF MARYLAND

BALTIMORE CAMPUS

UNIVERSITY of MARYLAND

FDA

Wrap Up

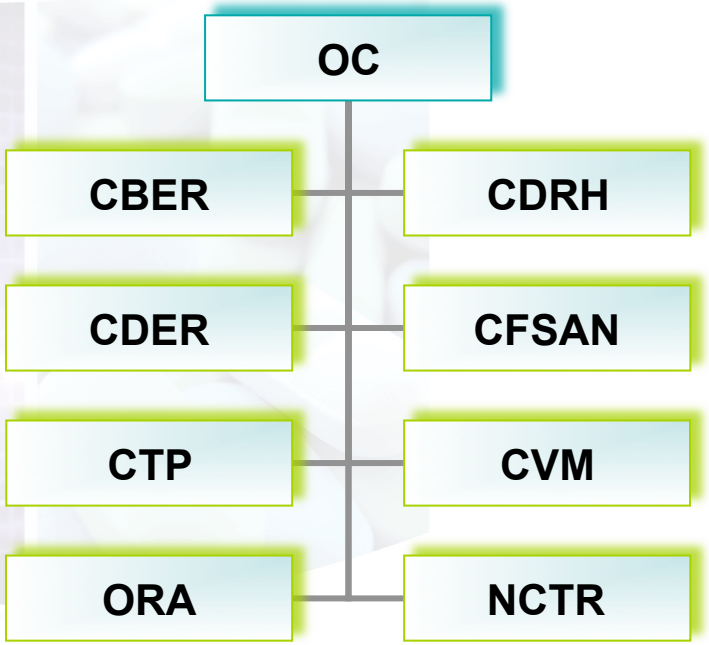
Emerging Technologies at FDA

A Program Perspective

- Agency's Regulatory Science approach within the Strategic Plan for Regulatory Science
  - Priority Area 4 - Emerging Technologies
    - Implementation Plan
- Cross Agency Working Groups
    - Science
    - Regulatory Research
    - Policy
    - Staff Training & Professional Development
    - Communication
- Topic Specific Advances

A Few Topic Areas[1]

Systems Biology
Wireless Health Care Devices
Robotics
Nanotechnology
Medical Imaging
Cell and Tissue Based Therapy
Regenerative Medicine
Combination Products



1. FDA Mission at Risk Science Board Report, 2007

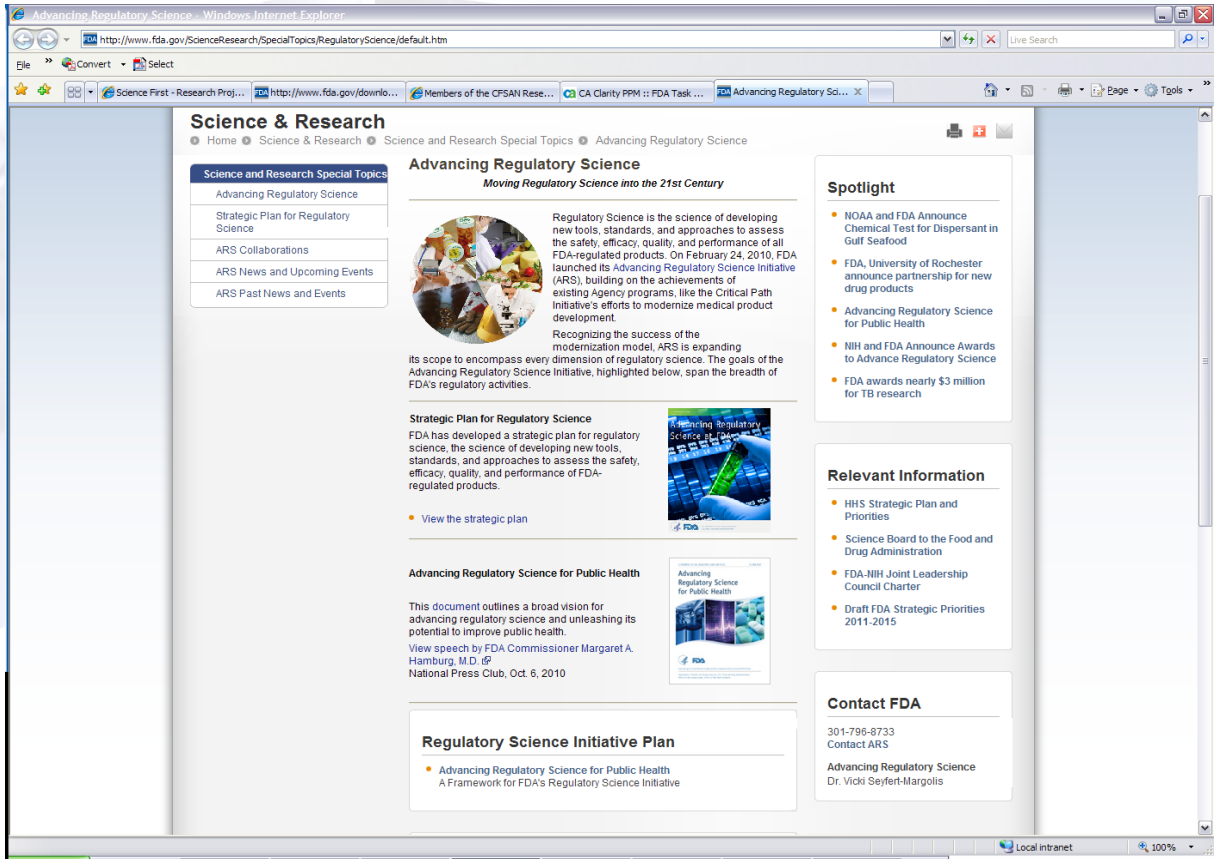
Principles for Regulation and Oversight of Emerging Technologies[1]

- Scientific Integrity
- Public Participation
- Communication
- Benefits and Costs
- Flexibility
- Risk Assessment and Risk Management
- Coordination
- International Cooperation
- Regulation

1. Memorandum for the Heads of Executive Departments and Agencies, March 11, 2011

Advancing Regulatory Science Website

http://www.fda.gov/ScienceResearch/SpecialTopics/RegulatoryScience/default.htm



Questions

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