

Regulatory Science Competencies in 11 Core Thematic Areas

Regulatory Science Research Questions and Priorities

- ① Summarize current and emerging Regulatory Science priorities, including FDA Priority Areas and others
- ② Identify additional Regulatory Science questions via gap analysis of translational research pathway, considering current evaluation and approval process of medical products
- ③ Critique Regulatory Science research questions and priorities
- ④ Identify approaches and techniques to address areas of Regulatory Science; outline a vision for a research program
- ⑤ Describe principles of decision science and evidence based decision making, considering the role of patients, patient advocates, clinicians, payors, and regulators
- ⑥ Describe principles of Team Science, including the specific roles within a multidisciplinary network of individuals in and across organizations

Regulatory Policies and Process

- ① Understand current regulatory system and structure appropriate to the relevant field of study
- ② Evaluate and analyze laws, regulations, and guidance documents relevant to the field of study
- ③ Apply proposed regulatory strategies for the design and development of a medical product from bench to bedside, analyzing opportunities and challenges within current regulatory framework

Research Ethics

- ① Explain the ethical principles and requirements related to the development of new regulations and guidance documents
- ② Identify current and emerging research ethics issues in Regulatory Science, including clinical trials
- ③ Discuss issues of risk-benefit disclosure during the process of consent
- ④ Define COI and discuss financial and non-financial examples of conflict with nascent approaches including mediating and monitoring techniques
- ⑤ Develop an understanding of current risk-benefit assessment initiatives and requirements; while identifying opportunities and challenges of implementing new approaches to risk-benefit assessment, including for emerging innovative technologies
- ⑥ Define, identify and apply ethical issues and implications for dual-use research

Drug Discovery and Development

- ① Describe the traditional process of drug discovery and development, including target identification, validation, lead molecule identification and optimization
- ② Discuss incorporation of new technology to further target identification (High-Throughput Screening, in vitro models, lead optimization and qualification, systems biology, network analysis, human organs on chips)
- ③ Describe importance of correlating in vitro models for applicability to toxicology, target mechanism, metabolism
- ④ Identify and understand the relative utility of biomarkers and surrogate endpoints for addressing questions of efficacy and toxicity
- ⑤ Outline parameters for clinical proof of mechanism and proof of concept

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Medical Device Innovation

- ① Outline the process to translate a preclinical or clinical observation into a clear statement of Regulatory Science need
- ② Discuss how to filter and prioritize needs based on safety, quality and regulatory impact and other considerations
- ③ Identify needs in applying quality systems regulations to product development
- ④ Describe preclinical and clinical tests necessary to show effectiveness
- ⑤ Understand how to apply Regulatory Science approaches to respond to necessary post market changes

Preclinical

- ① Evaluate the stages of preclinical testing in the context of drug and device development
- ② Describe how to define preclinical testing requirements and design appropriate pre-clinical study
- ③ Describe the basic principles for GLP research and when such methods are needed
- ④ Explain how the preclinical results fit with formulation and clinical aspects of drug development
- ⑤ Describe selection, qualification and innovation of animal models and animal model alternatives to promote novel clinical trial design
- ⑥ Explain the need to develop better preclinical models of human adverse response (e.g. cell/tissue based assays) that more accurately represent human susceptibility to adverse reactions
- ⑦ Explain the need to evaluate data at multiple levels (e.g., genes, proteins, pathways, cell/organ function) to better understand toxicity mechanisms
- ⑧ Describe the need for identification and evaluation of biomarkers and how related endpoints can be used in pre-clinical evaluations

Clinical Trials

- ① Describe the stages of individual clinical trials
- ② Outline the design/elements of an appropriate clinical trial for a medical product
- ③ Understand options for alternative/novel clinical trial designs (including adaptive trial design) that may be more informative, impactful and/or efficient for special needs (e.g., small trials for orphan indications, designs and endpoints for pediatric and neonatal trials)
- ④ Describe adverse event management strategies within individual trials and development programs, both pre and post-marketing
- ⑤ Outline potential for pharmacogenomic approaches to refine target populations and opportunities for parallel co-development of drugs and diagnostics
- ⑥ Describe the role for pharmacometrics in clinical studies and the drug approval process
- ⑦ Discuss parameters for testing in specialized populations (e.g., pediatrics, geriatrics, altered organ function, cardiac toxicity)
- ⑧ Understand how outcomes of trials might vary if the study population differs significantly from the targeted population for use.
- ⑨ Explain the need to identify improved clinical endpoints and related biomarkers
- ⑩ Describe the use of modeling and simulation to enhance clinical trial design and effectiveness

Post-Marketing and Compliance

- ① Outline the role of the FDA in post-marketing processes
- ② Describe the range of enforcement options available to the FDA when dealing with compliance issues
- ③ Understand the role of new technology as it applies to sampling and product testing for contaminated or counterfeit product

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Analytical Approaches and Tools

- ① Explain potential applications of computational methods and in silico modeling to predict human efficacy, toxicity and risk-benefit and to inform regulatory decisions
- ② Evaluate applications of statistical approaches, biomedical informatics and models (e.g., missing data, multiple endpoints, patient enrichment, adaptive designs) to promote novel clinical trial design
- ③ Describe basic statistical concepts (e.g., identify a research question, conceptualize hypotheses, identify sources of data, utilize appropriate study designs, determine appropriate analytical methods, draw valid and meaningful conclusions)
- ④ Describe the process to identify, evaluate, and synthesize information from RCTs, observational studies, and other study designs
- ⑤ Identify appropriate applications for various scientific methods to gather and validate information (e.g., systematic reviews, meta-analysis, etc.)
- ⑥ Describe principles and applications of various analytic tools and techniques (e.g., bioinformatics, patient-reported outcomes, clinical effectiveness research, translational research, etc.)
- ⑦ Discuss results from data mining techniques to explore existing clinical trial data (e.g., analysis of electronic health records from accessible large healthcare databases to identify sources of variation among studies, differentiate subsets of diseases, improve understanding of relationships between clinical parameters and outcomes, evaluate clinical utility of potential biomarkers and evaluate post-marketing data)
- ⑧ Describe use of informatics to inform both clinical trials and pharmacometrics
- ⑨ Outline current legal and policy requirements related to data storage, maintenance, access, privacy and security
- ⑩ Discuss approaches to address data storage, access, sharing, privacy and confidentiality (including patient, industry, government and other data sources)
- ⑪ Describe requirements and permissions associated with Biobanking tissue and others collections
- ⑫ Describe use of novel strategies and existing data sets for repurposing

Communication

- ① Compare and contrast communication, evidence-based communication, and risk communication
- ② Explain approaches to risk communication and the underlying social and behavior sciences that inform these approaches
- ③ Describe various research approaches that inform regulatory decisions (e.g., focus groups, surveys, experiments, etc.)
- ④ Discuss results-oriented approaches, and corresponding evaluation criteria, to achieve short- and long-term goals of communication strategies
- ⑤ Effectively communicate the value of Regulatory Science, including priorities and gaps to stakeholders, including colleagues, policy makers, the media, and the public
- ⑥ Discuss the need to provide guidance to sponsors and manufacturers about how to effectively and transparently communicate the risks, benefits and uncertainties of regulated products to the public
- ⑦ Recognize international and cultural aspects in developing communication plans, including the roles for international organizations

Technology and Innovation

- ① Describe emerging key technology areas and how they may impact Regulatory Science processes and policies (e.g., manufacturing, toxicology, etc.)
- ② Explain the global nature of medical product innovation and technology development
- ③ Outline aspects impacting economic viability of novel medical products, including the role for payors in coverage and reimbursement decisions