# 2022 Course Syllabus

## Drug Development Course: From Molecule to Prescription

### Weill Cornell Graduate School - Tri-Institutional Therapeutics Discovery Institute

**ABOUT THIS COURSE**

This course has been designed in collaboration with drug development experts from Roche and provides a foundation of integrated knowledge of the multi-disciplined process of developing a new medication. It includes real world challenges encountered in the areas of discovery, development, manufacturing, global regulatory approval and commercialization of new medicines. In addition, the impact of emerging technologies to healthcare and the development process will be considered.

While each lecture could be a topic for one (or more) graduate course, the goal of this integrated program is to provide an introduction to the whole drug development process, to raise awareness of all the different aspects that need to be considered to bring new medicines to patients, and to elicit interest for young investigators.

**WHO IT IS FOR**

Graduate students in the life sciences who are future researchers, prescribers or potential participants in the development process will benefit from this comprehensive view of how drugs are developed.

**FACULTY**

The lectures will be given by professionals with expertise and long experience in drug development most of whom work at Roche or have worked at Roche. The current list of instructors is draft and will be defined based on recommendations and approval by Roche senior management for each specific subject matter

**STRUCTURE**

12 Lectures (1.5 - 2 hr. each) including real world case studies
Target size: approximately 40 students
Students will be divided in 6 - 8 groups, at the beginning of the course a “research problem’ will be assigned to each group. It is expected that at the end of the course each group will present their assignment and proposed solutions (i.e. 20 min presentation and 10 min for Q&A)
Assessment: Mid Term and Final Exams (multiple choice), plus evaluation of the research exercise

**TIME and LOCATION**

Thursdays starting on **January 6, 2022** (3 – 5 pm), **In-Person + Virtual if needed TBD (Zoom invite)**

**Session 1 – Jan 6**

**Overview of the Discovery and Development Process**

*Instructor: Ignacio Rodriguez, MD, Head Patient Safety - Immunology, Hepatology & Dermatology, Novartis Pharmaceuticals*

- Drug Development Pathway: how to go from molecule to medicine
- target product profile
- types of compounds (small molecules - biologics - antibody / drug conjugates, vaccines)
- different phases in development, approval, and life cycle management
- current and future drug development process
- success metrics, timelines, costs

**Session 2 – Jan 13**
**Overview of the Discovery Process**
*Instructor: Christian Gampe, PhD. Senior Scientist, Medicinal Chemistry, Genentech, South San Francisco, CA*

- Target identification and validation
- assay development and screening
- animal models of disease
- Lead identification, lead optimization and clinical candidate selection

**Session 3 – Jan 20**
**Non-Clinical safety and DMPK considerations**
*Instructors: Gaurav Tyagi, BVSc, PhD, DACVP, DABT, Principal Scientist, Pharmaceutical Sciences; Li Yu, PhD, Pharmaceutical Sciences, Expert Scientist Pharmacokinetics, Dynamics and Metabolism Leader; Roche Innovation Center New York*

- What are desirable ADME properties?
- Points-to-consider in DMPK at different stages for drug discovery and development
- Translational PK/PD modeling
- Early in vitro tests to screen and predict toxicity
- Regulatory Toxicology (including ICH guidelines)
    - GLP vs non-GLP studies
    - Acute vs Chronic studies (selection of species, duration and evaluation)
    - Safety Pharmacology
    - Mutagenicity and Carcinogenicity studies
    - Reproductive and Developmental Toxicology studies
- Mechanistic Toxicology (including biomarkers)
- New trends in preclinical evaluation (integrated assessments, organ on a chip, stem cells, etc.)
- Differences between evaluation of small molecules & biotherapeutics

**Session 4 – Jan 27**
**Transforming Novel Molecules to Medicines: Technical Perspective**
*Instructor: Hitesh Chokshi PhD, Senior Leader, Pharma Technical Development, Roche Innovation Center New York*

- CMC activities, partners, and deliverables
- How “drug like” is molecule.
    - Developability alerts
    - Target drug product profile
    - Scalability of API and drug product to meet clinic / market demand
    - Process and product quality attributes --> Robust product
- Drug Delivery – Past, Present and Future
- Future drug modalities – Challenges and Opportunities

**Session 5 – Feb 3**
**Use of Emerging Technologies to Address Industry Challenges**
*Instructor: James Cai PhD, Head of Data Science, Roche Innovation Center New York*

- Emerging Technologies and approaches in drug development
- Use of biomarkers and diagnostics
- PHC
- Real world data
- Use of electronic medical records

**Session 6 – Feb 10**
**Strategic & Tactical Considerations and Business Models**
*Instructor: Patrick Schleck, Pharm D, MBA, Global Executive - Vice President Immunology And Infectious Disease, Genentech, South San Francisco, CA*

- Indication Selection
- Risk Tolerance
- Target Product Profile
- Global Product Strategy
- Team Structure
- Roles and Functions
- Partners: Investigator Sites, CROs, Patient Advocacy Organizations, Disease Foundations
- Overview of business models in drug development
    - How to get funding
    - Commercial aspects of the TPP
    - Return on investment
    - Patent life

**Session 7 – Feb 17**
**Biostatistics in drug development**
*Instructors: Steven Blotner, Principal Statistical Scientist, Clinical Operations; and Michael Rabbia, Senior Principal Statistical Scientist, Neuroscience; Genentech, South San Francisco, CA*

- role in the different phases
- novel designs (example: CRM vs. 3+3)
- Types of Endpoints in Clinical Trials
- Blinding, Randomization, and Stratification
- Hypothesis Testing and Error Probabilities
- Multiple Testing
- Interim Analyses
- Sample Size and Trial Duration
- Minimum Detectable Difference
- Confidence Intervals
- P-Values

**Session 8 – MID-TERM EXAM – Feb 24**

**Spring Break – Mar 3**

**Session 9 – Mar 10**
**Clinical Safety and Pharmacovigilance**
*Instructor: Felix Arellano, MD, Global Head Safety Management, F. Hoffmann-La-Roche, Basel, Switzerland*

- What is expected at each phase
- Principles of Pharmacovigilance
- Expected and Unexpected AE in clinical trials
- SUSAR and Reference Safety Information
- Safety Signals and Signal Detection Plan
- Risk Management Plans
- Post approval safety commitments

**Session 10 – Mar 17**
**Overview of Early Clinical Development and Key Concepts and Role of Clinical Pharmacology in supporting Early Clinical Development**
*Instructor: Joseph, Grippo, PhD, Expert Scientist, Clinical Pharmacology, Roche Innovation Center New York*

- Key goals in early clinical development
- How to design and conduct First in Human and Phase II Studies
  - Translating preclinical data to clinical
  - Study design questions: study design options- parallel group, crossover, adaptive, randomized, blinding
  - Dose selection, dose progression (safety and PD/efficacy considerations
  - Healthy volunteer and patient selection
  - Proof of Mechanism / Proof of Concept
- Role of Clinical Pharmacology in the early clinical development
  - What is the discipline of Clinical Pharmacology
  - Absorption, Bioavailability, Distribution, Metabolism, and Elimination
  - Dose-Exposure relationships
  - Clinical Pharmacodynamics
  - Exposure response analysis: Biomarkers/surrogate efficacy measurements
  - Principles of PK/PD modeling and simulation
  - Supporting studies (DDI, Special Populations, Abuse Liability, TQT)

**Session 11 – Mar 24**
**Confirmatory Phase and Post Approval Activities**
*Instructor: Larry Tsai, MD, Global Head of Respiratory and Rheumatology Product Development, Genentech, South San Francisco, CA*

- Pivotal Phase 3 studies
  - Key objectives
  - Logistical considerations
  - Choice of controls
  - Subgroup analysis
  - Interim Analyses (early stops for futility, safety or efficacy)
- Safety database
- What else is needed in this phase
- Regulatory submission for approval
- Post Approval Activities (surveillance, post approval safety studies, new indications)

**Session 12 – Mar 31**
**Drug Development is a Tightly Regulated Science**
*Instructor: Megan Zoschg Canniere, Pharm D, Head of Regulatory Affairs, Spark Therapeutics, Inc, Philadelphia, PA*

- History of Regulation
- Regulatory requirements in different countries (focus on FDA and EMA)
- Regulatory interactions at different phases of development
- CTA - IND - NDA
- Tools for expedited review and approval
- Safety database
- Regulatory compliance and post approval commitments
- Pediatrics

**Session 13 & 14 – Apr 14 and 21**
**Project Presentations** (class)

- Each group will present their case study and the recommendations
- Sessions will be graded by a panel of experts from the lecturers and experts from the academic institution

| **Session 15 FINAL EXAM – Apr 28** |
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