Downing - Keio Summer School 2019

Strand A: Healthcare and Biotechnology Course Outline

This course aims to provide an overview of the current challenges in Science and the importance of key aspects that are essential in addressing the needs for an evolving global population. Increasing capability for developing new tools for diagnostic and prognostic applications in medical sciences, are now presenting new challenges for disease treatment and management.

Presented in this course are the current developments in healthcare, and how our basic understanding in Biology has evolved over the past two decades. Key aspects on what are the current capabilities in concept such as Drug Discovery and Development are discussed as well as their shortfalls highlighted. In addition, an overview of the current challenges that are faced by scientists will also be discussed, as well as the need to develop technologies to address current and future demands; from tackling diseases such as cancer and outbreaks such as Ebola to addressing issues of the global ageing population.

Week 1: Discovery Biology – Basic knowledge and tools used in Research and Development

*Lecture 1. & 2. **Introduction to Biology -*** General Introduction and terminology in biology. Introduction to body, organs, tissues and cell components (genes, proteins, carbohydrates and lipids and metabolites) in relation to cell compartmentation versus their functions in health and diseased subjects. Current achievement in biomedicine and unmet clinical needs.

*Lecture 3. & 4. **Gene structure and functions -*** Introduction to genes (DNA and RNA) and the corresponding techniques/platforms (Genomic and transcriptomic) used to investigate gene structure and expression level – Example of medical breakthroughs (Diagnostic/Prognostic).

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Lectures 5. & 6. *Proteins, carbohydrates and lipids structure and functions -* Introduction to proteins (proteins, peptides and antibodies) and the corresponding techniques/platforms (proteomic and lipidomics) used to investigate protein structure and expression level – Example of medical breakthroughs.

Lectures 7. & 8. *Cellular/Animal models used in discovery biology -* Type of cellular models used for drug discovery- Challenges (Validation/Cryopreservation) and opportunities (e. g. biopharmaceuticals based-therapies/Stem cell, fertility treatment).

Type of animal models (genetic/chemical/behaviourally induced models) currently used in drug discovery. At which stage do use them and are they representing the human diseases?

Lectures 9. & 10. *Workshop*

How to write a scientific assay/paper:

1. Introduction: Known, unknown and what do we want to know?
2. Material/facts – Preclinical (Cellular and/or animal) models used in discovery biology – Pro, cons and future alternatives
3. Discussion – Use the PEC (P = Point; E = Evidence and C = Comment) model.

Reading List

1. Biochemistry – Lubert Stryer 7th edition – See:

    https://archive.org/details/BiochemistryStryer7th
2. Cellular models – See:

    https://onlinelibrary.wiley.com/doi/pdf/10.1111/1541-4337.12158

    https://pdfs.semanticscholar.org/9c6b/dc364a9618731d52098eb6d15147be7b512c.pdf
3. Animal models – See:

    https://www.sciencedirect.com/science/article/pii/S2307502314000022

    http://www.medsci.org/v10p0206.pdf

    http://www.oarsijournal.com/article/S1063-4584(10)00241-4/pdf

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Week 2: Research and Development (R&D) – From Laboratory to Patients

*Lecture 1. & 2. **Introduction to healthcare and Biotechnology -** Historical background & terminology of pharmaceutical/biotechnology and healthcare industries. Current challenges (Clinical needs/Cost/Aging population/Generic drugs) and opportunities in pharma industries (e. g. Biopharmaceutical /Gates foundation). General introduction to medicine biology and R&D pipelines.

*Lecture 2. & 3. **R&D pipeline: Pre-clinical studies -** Cellular models and Drug screening; Chemistry and bio-informatics to generate novel compounds. Cellular/Animal models used to investigate drug toxicity and efficacy. Drug attrition issues - Findings to the appropriate animal models prior testing medicine on humans.

*Lectures 3. & 4. **R&D pipeline: Human clinical studies and introduction to personalised medicine -** Proof of concept studies, phase 1 to Phase 4 clinical trials)**.** Drug attrition: efficacy/toxicity and FDA approval issues (Global monitoring and marketing issues post launch). How novel are discovered? Introduction to personalised medicine/healthcare.

*Lectures 5. & 6. **Biomarkers & companion diagnostic -** Biomarkers definition (protein/gene lipids and techniques & platform used to discover biomarkers). Use of global bio-banking to investigate and validate biomarkers. Translating the relevant biomarkers to companion diagnostic for a newly discovered drug.

*Lecture 7. & 8. **Current & future directions for Healthcare & Biotechnology industries**:

1. Are the existing animal models relevant to the human diseases? - Alternatives preclinical model (e. g. Stem cells/organ culture)

2. New horizons - Biopharmaceuticals

3. Traditional drug discovery and development versus personalised medicine strategy

4. Job Market for you in the pharmaceutical industries?

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Scientists/Clinicians/Nurses/Engineers/consulting/HR/Statistician/Mangement etc.)

***Lecture 9. & 10**. **Workshops:** 1) <u>Selecting a disease to treat</u> (**why**: Market study/cost/clinical needs), 2) <u>Drug discovery</u> (**how** to go about discovering a new drug to treat such disease (e.g. Drug discovery pipeline*); 3) <u>Clinical trials </u>in humans. Scenarios of success and failure - Use historical examples.

Reading List

1. https://en.wikipedia.org/wiki/Drug_discovery
2. From Idea to Market: The Drug Approval Process. Martin S. Lipsky, MD, Lisa K. Sharp, PhD, Department of Family Medicine, Northwestern University Medical School, Chicago. J Am Board Fam Med. 2001;14(5). Or see http://www.medscape.com/viewarticle/405869_4
3. http://www.medscape.com/viewarticle/405869_4
4. Is there a British Journal of Pharmacology (2011) 162 1239–1249 1239

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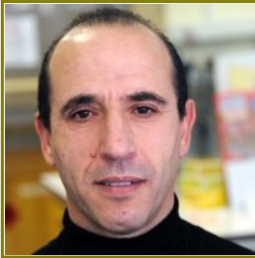
Dr. Hasssan Rahmoune

Department of Chemical Engineering and
Biotechnology, University of Cambridge

Dr Hassan Rahmoune (PhD) has over 26 years relevant experience in Pharmaceutical (GlaxoSmithKline/UK), Biotechnology (Rodaris/UK) and Academic (University of Cambridge/UK) environments. He has also developed a solid research background with over 90 scientific publications in a number of therapeutic areas such as Diabetes, Cancer, Respiratory and neuropsychiatric diseases.

As a senior Researcher/Technical officer at the University of Cambridge, he is currently: i) involved in supervising under/post graduates students and postdocs; ii) working towards establishing translational sciences within an academic environment. Over this time and in collaboration with multiple academic/pharmaceutical partners, he has established a global (US/European) clinical network to evaluate the potential application(s) of biomarkers as diagnostic tool.

Prior to his current academic position, he was heading the biomarkers discovery group at GlaxoSmithKline to translate his laboratory discoveries into a clinical setting. He pioneered the introduction of biomarkers arms into clinical trials to facilitate the implementation of personalised medicine strategies. As a member of the clinical matrix team, he also had the responsibility for: i) introducing biomarkers arm and scientific rigor into preclinical and human studies to aid clinical development.