LSMP 121
PROSEMINAR IN MANAGEMENT & THE LIFE SCIENCES

Freshman Year, Fall Semester 2017
Vagelos Life Sciences & Management Program

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Class Meetings: **Tuesday/Thursday, 10:30 AM – 12:00 PM**
Classroom: CPC Auditorium

Introduction and Course Objective

This is the introductory course for the joint Wharton-College Life Sciences & Management (LSM) Program. Enrollment is limited to students admitted to that program; no other Wharton or College students are permitted to enroll. The objective of this seminar-type course is to introduce students to the multiple dimensions in which the life sciences, society, markets, and firms interact in market-based economic systems. The course deals with three fundamental issues in the management of science:

(1) allocation of resources, public and private, to the discovery and development process
(2) organization and management of the 'twin towers' of innovation –
research and discovery (R&D)
commercialization – the translation of discoveries into products/services
(3) prioritization and marketing of useful products and services

All three questions will be considered from a descriptive/behavioral viewpoint—how do they actually occur—and from a normative/social viewpoint—how should they ideally occur? The course will be led by Robert Burns from Wharton and Philip A. Rea from the Department of Biology, and will rely on both outside speakers and lectures/discussions with the course faculty. Written papers, participation in class discussion, and student presentations will form the basis for grading.

Course Sequencing

The course has four major sections. The first section discusses the changing rates of discovery in the life sciences, the sources of creativity that lead to discovery, and whether the creative process can be managed. We then illustrate some of these themes in a case study of the discovery of statins. This section also sketches the history of the management of science. The second section of the course discusses the prospects and problems for the development and implementation of new discoveries in genomics. Genomics applications are considered in cancer therapy and cardiac therapy (regenerative medicine). The third section of the course provides an overview of the life sciences sectors (pharmaceuticals, biotechnology, information technology, and medical devices), the major trends occurring within each, and the central issues that need to be confronted. The final section of the course discusses start-up companies and the requirements for commercialization. Please note that the classes corresponding to each section may not be contiguous because many of the speakers who were so kind as to contribute to the course have very tight schedules that necessitated their speaking on days other than those that would have been ideal for the course sequence.

Assignments

Students will have two major assignments:

(1) A paper critically examining the translation process for new beneficial life sciences products and what government, firms, investigators, investors, and universities have done or are doing well or ought to do differently in the context of some aspect of genomics and consumer need. The first draft, which will be commented on by the faculty and returned to the students for preparation of the final draft, is due on October 17th. The final draft is due on November 30th.

(2) An oral briefing to be presented at the end of the semester together with written background material on a "market scan" that identifies a product or area in which scientific discoveries might match consumer demands/needs, and which outlines a translational strategy. For the background research and presentations, students will be grouped into six teams. The teaching assistants – second-year MBA students in Wharton's healthcare management program who have science backgrounds – will serve as team advisors.

There will also be two very short ('one-pager') writing assignments which will form the basis for formulating ideas, researching small sections of the literature and/or enlarging on some of the ideas discussed in class. The topics will cover 'superbugs' and strategic planning in life sciences firms. Due dates for the two papers are September 14th and November 9th. See the syllabus for those dates for more details.

Readings

Reading assignments for this course will be taken from:

(a) Burns, *The Business of Healthcare Innovation* 2nd Edition, (Cambridge University, 2012) which is available for purchase at the bookstore.

(b) Book chapters compiled into a coursepack which is available for purchase through www.study.net ; the coursepack materials are marked in the syllabus with an asterisk [*].

(c) Readings that will be posted to the course e-room on *Canvas*. You can access *Canvas* directly through the following link: https://canvas.upenn.edu or use your "My Courses" tab through the SPIKE student portal: http://spike.wharton.upenn.edu/. You will need your Wharton ID and password to log in.

COURSE OUTLINE

August 29: Introduction to the course and general introductions
The twin towers of innovation & R&D trends in the pharmaceutical discovery. (Burns)

Readings

Burns, *The Business of Health Care Innovation*: Chapter 8.

USFDA. *Novel Drugs 2015 Summary* (2016).

August 31 Economic and managerial perspectives on innovation in the life sciences

Readings

Gertner, *The Idea Factory* (Read pp. 101-104, 150-155, 260-263, 343-360). [*]

September 5: Theories of innovation and creativity (Dr. John Kounios, Drexel University)

Readings

John Kounios. *The Eureka Factor*, Chapters 1 & 2. [*]

September 7: Translational research in genomics and personal genome sequencing (Marc S. Williams, M.D., Director, Geisinger Genomics Institute, Danville, PA)

Readings
McCarthy, McLeod, and Ginsburg, "Genomic medicine: A decade of successes, challenges, and opportunities," *Science Translational Medicine* 5 (12 June 2013): 189sr4.

Williams. "Moving from genetics to genomics: Forget evolution vs. revolution – Is it a solution?" Chapter 11 in *Managing Discovery in the Life Sciences* (forthcoming, Cambridge University Press).

Williams. "Genomic medicine implementation: Learning by example," *American Journal of Medical Genetics* 166C (2014): 8-14.

Carey et al. "The Geisinger MyCode community health initiative." *Genetics in Medicine* 18(9) (2016): 906-913.

Dewey et al. "Distribution and Clinical Impact of Functional Variants in 50,726 whole-exome sequences from the DiscovEHR Study." *Science* 354(6319) (2016).

September 12:
September 14:

The statins - from the obscure to the billion dollar pill. Humble origins and fungal beginnings. Lipitor and the power of plan B – an advantage of a disadvantage made. Collateral benefits – from the basic to the practical and back. "Evergreened" blockbusters. (Rea)

Readings

Libby, "Atherosclerosis: the new view," *Scientific American* (May 2002): 47-55.

Rea, "Statins: from fungus to pharma," *American Scientist* 96 (2008): 408-415.

Rea. "The statins - cholesterol's 'penicillins'," Chapter 5 in *Managing Discovery in the Life Sciences* (forthcoming, Cambridge University Press).

Articles for first one-pager (due 9/14):

Sun and Dennis, "The superbug that doctors have been dreading just reached the U.S.," *Washington Post* (May 27, 2016). For instructive videos associated with this publication go to https://www.washingtonpost.com/news/to-your-health/wp/2016/05/26/the-superbug-that-doctors-have-been-dreading-just-reached-the-u-s/

Yong, "The plan to avert our post-antibiotic apocalypse," *The Atlantic* (May 19 2016).

"Antibiotic resistance. The grim prospect," *The Economist* (May 21, 2016).

"Resistance isn't futile – how to tackle drug-resistant superbugs," *The Guardian* (July19, 2015).

September 19 Translational research in genomics: going beyond the clinic to make a population-level impact (Sheri Schully, Ph.D., National Institutes of Health, Office of Disease Prevention)

Readings
Khoury, Evans. A public health perspective on a national precision medicine cohort: Balancing long-term knowledge generation with early health benefit. *JAMA* 313(21) (2015): 2117-2118.

Schully et al. "Evidence synthesis and guideline development in genomic medicine: Current status and future prospects," *Genetics in Medicine* 17(1) (19 June 2014):63-64.

Evans and Khoury. "The arrival of genomic medicine to the clinic is only the beginning of the journey," *Genetics in Medicine* 15 (10 July 2013): 268-269.

Manolio et al. "Implementing genomic medicine in the clinic: The future is here," *Genetics in Medicine* 15(4) (10 January 2012): 258-269.

September 21 Cancer genomics applications (Brian Keith, Ph.D., Director of Education, Abramson Family Cancer Research Institute, Perlman School of Medicine)

Readings
Vogelstein et al., "Cancer genome landscapes," *Science* 339 (2013): 1546-1551.

Visit *Inside Cancer* (especially watch "Hallmarks of Cancer"): http://www.insidecancer.org

September 26 Promises and challenges for utilizing cancer genomics to improve patient outcomes: Focus on childhood cancers (John Maris, M.D., Division of Oncology, Children's Hospital of Philadelphia).

Readings
Schnepp et al. "Improving patient outcomes with cancer genomics," *JAMA* 314(9) (September 1, 2015): 881-883.

Maris. "Defining why cancer develops in children," *NEJM* 373 (December 10, 2015): 2373-2375.

Mody et al. "Integrative clinical sequencing in the management of refractory or relapsed cancer in youth," *JAMA* 314(9): 913-925.

Zhang et al. "Germline mutations in predisposition genes in pediatric cancer," *NEJM* 373(24) (December 10, 2015): 2336-2346.

September 28 The investor's challenge: Moving discoveries to practice. Colon cancer genomics from an investor's perspective, followed by in-class exercise to discuss translation. Groups will discuss and develop examples in their experience of both promising ideas that were carried forward to success and promising ideas that failed to be translated – either appropriately or inappropriately. What made the difference? (Lee Schalop, M.D. and Wolfgang Oster, M.D., Ph.D., PolyTechnos Venture-Partners, Munich, Dublin, New York, San Francisco)

Readings

Frechtling et al., *The CTSA National Evaluation Final Report*. (Westat, April 2012).

Booth. "Foundings matter: Thiel's law applied to biotech," *Biotech Financing* (June 11, 2013).

Price. "Overhauling translational thinking," (2013).

October 3 Overview of life sciences regulation: FDA and drug approval. (Debbie Cooper, Ph.D., DR Cooper Consulting, LLC)

Readings

Thaul. *How FDA Approves Drugs and Regulates Their Safety and Effectiveness*. Congressional Research Service. (June 25, 2012).

Food & Drug Administration. *Guidance for Industry.*

HBS Case. *Note on the U.S. Food and Drug Administration*. Case # 9-807-050. [*]

Christl. *Overview of the Regulatory Framework and FDA's Guidance to the Development and Approval of Biosimilar Products in the US*. Skim slide presentation. USFDA.

October 5 **Fall Break – no class**

LDI Symposium

October 10 Issues in translational medicine. (Garret FitzGerald, M.D., McNeil Professor in Translational Medicine and Therapeutics, Associate Dean for Translational Research. University of Pennsylvania, Perelman School of Medicine)

Readings

Fitzgerald. "Anecdotes from ITMAT: Building capacity for translational science," *Clinical Pharmacology & Therapeutics* 94(3) (2013): 291-296.

Fitzgerald. "Evolution in translational science: Whither the CTSAs?" *Science Translational Medicine* 7(284) (2015): 1-3.

Cappola and Fitzgerald. "Confluence, not conflict of interest: Name change necessary," *JAMA* 314(17) (2015): 1791-1792.

Fitzgerald. "Measure for measure: Biomarker standards and transparency," *Science Translational Medicine* 8(343) (2016): 1-2.

October 12 Overview of medical device sector. Conflicts of interest in research, sales, and marketing. (Mark Turco, M.D.)

Readings

Chatterji et al. "Physician-industry cooperation in the medical devices industry." *Health Affairs* 27(6) (2008): 1532-1543.

Donovan and Kaplan. "Navigating conflicts of interest for the medical device enterpreneur." *Progress in Cardiovascular Diseases* 55(3) (2012): 316-320.

Health Policy Brief. *The Physician Payments Sunshine Act*. RWJF (2014).

Burns, *The Business of Healthcare Innovation*. Chapter 6.

October 17 Defining the actionable cancer genome (David B. Solit, M.D., Geoffrey Beene Chair in Cancer Research; Director, Marie- Josée and Henry R. Kravis Center for Molecular Oncology, Memorial Sloan Kettering Cancer Center)

Readings

Hyman et al. "Precision medicine at Memorial Sloan Kettering Cancer Center: Clinical next-generation sequencing enabling next-generation targeted therapy trials," *Drug Discovery Today* 20(12) (2015): 1422-1428.

Koboldt, et al. "The next-generation sequencing revolution and its impact on genomics," *Leading Edge Review* (September 2013).

Iyer et al. "Genome sequencing identifies a basis for Everolimus sensitivity," *Science*

338(6104) (October 12, 2012): 21 and *Supplementary Materials*.

Zehir et al. "Mutational landscape of metastatic cancer revealed from prospective clinical sequencing of 10,000 patients," *Nature Medicine* 23(6) (2017): 703-713.

October 19

Commercial development of life sciences research (Steven Nichtberger, M.D., M.B.A., Serial Entrepreneur and Investor, Adjunct Professor, Wharton Health Care Management Department)

HBS Case: *Tengion: Bringing regenerative medicine to life*. Case # 9-510-031. [*]

Atala, Bauer, Soker, Yoo, and Retik, "Tissue-engineered autologous bladders for patients needing cystoplasty," *The Lancet* 367 (2006): 1241-1246.

http://www.youtube.com/watch?v=kIu0gB-day0 (CBS Evening News: "Growing Miracles," Part 1.

October 24
October 26

Overview of pharmaceutical development and delivery process. (Robert Willenbucher, M.D., M.B.A., Head of Cell Therapy and Jannsen Incubator).

Readings
Ng. *Drugs: From Discovery to Approval*. Chapters 7 and 8.

October 31

Overview of the pharmaceutical sector (David Blumberg, Former Principal, U.S. Pharmaceuticals and Life Sciences Advisory, KPMG LLP)

Readings
Burns, *The Business of Healthcare Innovation*. Chapter 2.

November 2

Cost-effectiveness, comparative effectiveness: Achieving market access for pharmaceuticals. (Robert DeMarinis, Ph.D., Principal, AccessPharmaCon; former Vice President, Global Health Outcomes Assessment at Wyeth).

Readings
Kanters et al. "Systematic review of available evidence on 11 high-priced inpatient orphan drugs," *Orphanet Journal of Rare Diseases* 8 (2013): 1-7.

IMS Consulting. *Pricing and Market Access Outlook*. 2015/2016 Edition. [SKIM]

November 7

Regenerative medicine. (Prof. Jonathan Epstein, M.D., Executive Vice-Dean and Chief Scientific Officer, William Wikoff Smith Professor of Medicine, School of Medicine, University of Pennsylvania)

Readings
Lambers and Kume. "Navigating the Labyrinth of Cardiac Regeneration," *Developmental Dynamics* (2016): 751-761.

Lanza and Rosenthal, "The stem cell challenge," *Scientific American* (June 2004).

Minkel, "Potent alternative," *Scientific American* (February 2008).

Khademhosseini et al., "Progress in tissue engineering," *Scientific American* (May 2009).

http://stemcells.nih.gov/info/basics/pages/basics1.aspx

November 9 The health care value chain. Part I: Ecosystem of payers, providers, producers (Burns)

Readings
Burns, *The Business of Healthcare Innovation*. Chapter 1.

Moses et al. "The Anatomy of health care in the United States," *JAMA* 310 (November 13, 2013): 1947-1964.

Moses. "Supplemental Online Content."

Articles for second one-pager:

HBS Case: *"Amgen Inc.: Planning the Unplannable."*[*]

Gordon Binder, *Science Lessons* (2008): Chapters 3 and 4 (handout)

November 14 Venture capital and the life sciences. (Jason Rhodes, M.B.A., Partner, Atlas Venture)

Readings
Goodman, "Epizyme builds a cancer company at Mach speed," *In Vivo* 30 (May 2012): 1-7.

Kuratko and Brown, "Emerging life sciences ventures: The quest for legitimacy," *Business Horizons* 53 (2010): 211-220.

Booth, "If I were a big pharma head of R&D…" *Life Sci VC.* Available at: http://lifescivc.com/2013/08/if-i-were-a-big-pharma-head-of-rd/

Booth, "Lessons learned: Reflections on early-stage biotech venture investing," http://lifescivc.com/2013/02/lessons-learned-reflections-on-early-stage-biotech-venture-investing/

Life Sci VC. "VC-backed biotech IPOs: Valuations and virtuous cycles." http://lifescivc.com/2014/08/vc-backed-biotech-ipos-valuations-and-virtuous-cycles/

Fleming, "The decline of venture capital investment in early-stage life sciences poses a challenge to continued innovation, " *Health Affairs* (February 2015)

November 16 Overview of biotechnology sector. (Eric Schmidt, Ph.D., Managing Director, Cowen).

Readings
Ernst & Young, *Beyond Borders 2016: Biotech Financing.* Biotechnology Report (2016).

Burns, *The Business of Healthcare Innovation*. Chapter 4.

November 21 The health care value chain. Part II: Financing & delivery (Burns)

Readings

November 23 **Happy Thanksgiving – no class**

November 28 Overview of information technology and impact on health care. (William Hanson, M.D., Chief Information Officer, University of Pennsylvania Health System)

Readings
Burns, *The Business of Healthcare Innovation*. Chapter 7.

Dorsey and Topol. "State of Telehealth," *NEJM* 375 (2016): 154-161.

Mandl and Kohane, "Escaping the EHR trap – The future of health IT," *New England Journal of Medicine* 366 (June 14, 2012): 2240-2242.

Office of the National Coordinator for Health Information Technology, *Federal Health IT Strategic Plan 2015-2020* (Washington, DC: ONC).

Wang et al. Digital Health Funding: 2015 Year in Review (Rock Health, 2016).

November 30 Intellectual property and patent issues. (Marc Segal, M.S., J.D., Ballard Spahr LLP).

Readings

Holman. "AbbVie hopes to maintain Humira exclusivity through secondary patents and regulatory barriers to entry." *Biotechnology Law Report* 36(1) (2017), 9-16.

Gene Patents: A Brief Overview of Intellectual Property Rules. Congressional Research Service. (January 2014).

December 5 Market Scans

December 7 Market Scans