Reforming the Business of Pharmaceutical Innovation

Advising research, policy, and practice
March 16-18, 2021 | 9:00 am - 12:00 pm EST

Executive summary

Workshop #1, Assessing the value created by pharmaceutical innovation

This workshop will focus on how to assess the value created by pharmaceutical innovation, specifically the "health value" created by new products coming to market. Being able to assess the health value of new products is central both to the concept of value-based pricing of new drugs and also to assessing the public sector's return on investments in the basic or applied research that enables drug discovery and development.

The goal of this workshop is to identify approaches and parameters for assessing the health value created by public and private sector investments in biopharmaceutical innovation.

Background

Decades of research has demonstrated an association between the number of new drugs coming to market and various measures of population health, ranging from longevity and disability to the rate of admissions to hospitals or nursing homes. Nevertheless, increasing public concern about the affordability and availability of new drugs, along with concern about the innovativeness, efficacy, and safety of products to be approved through expedited review pathways, has placed new emphasis on cost-effectiveness as a means for defining a "reasonable" drug price or even a criterion in the review process.

At the same time, increasing recognition of the essential role played by government as an early-stage investor in innovation and market creation, as well as greater definition of the scale of the taxpayer investment in the basic and applied research requisite for drug development, has raised questions about the adequacy of the public sector's return on this investment. Moreover, with the purpose of the corporation being redefined as providing benefit to various stakeholders, it becomes increasingly important to have metrics to assess the health value provided to consumers of pharmaceutical products alongside the value provided to other stakeholders, including shareholders, employees, and communities.

Our work

A focus of our work has been on defining the economic inputs and outputs to pharmaceutical innovation. We have characterized the public sector investment in research directly related to new drug approvals from 2010-2019[1], research that is requisite for efficient drug discovery and development.[2] At the same time, we have described the economic value and new drug approvals arising from biotechnology companies with IPOs from 1997-2016[3] as well as the revenues, research spending, and profits of large pharmaceutical manufacturers[4]. Specifically:

- The annual number of new drug approvals (NMEs) increased from 2010-2019.
- The fraction of annual approvals designated first-in-class (FDA standard) remained unchanged.
- There was a significant increase in the fraction of NMEs receiving Priority or Breakthrough designations from 2010-2019, along with the average number of expedited designations/NME (**Figure 1**).

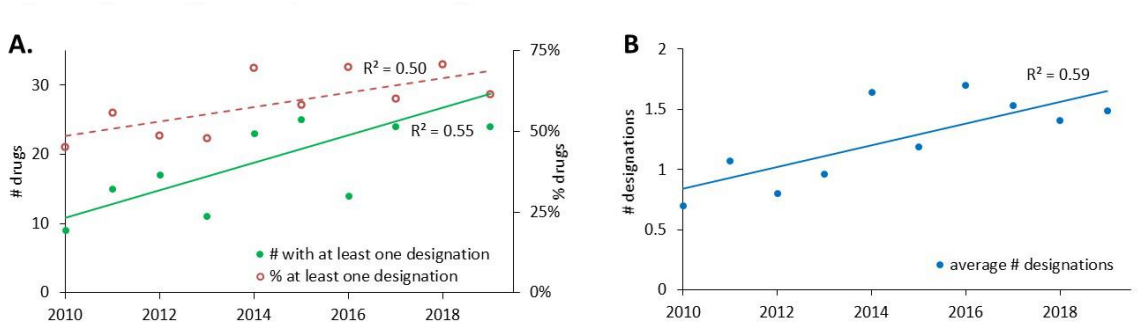

Figure 1. Expedited approval designations for drugs approved 2010-2019. A. Drugs with at least one expedited approval designation. B. Average number of expedited approval designations

[1] Cleary, E.G., Beierlein, J.M., Khanukja, N., McNamee, L.M., Ledley, F.D. (2018) Contribution of NIH funding to new drug approvals 2010-2016. *Proceedings of the National Academies of Science.* 115(10), pp.2329-2334. www.pnas.org/content/early/2018/02/06/1715368115
Cleary, E.G., Jackson, M.J., Ledley, F.D. (2020) Government as the first investor in biopharmaceutical innovation; evidence from new drug approvals 2010–2019. (Working Paper Series No. 133) www.ineteconomics.org/uploads/papers/WP_133-Cleary-et-al-Govt-innovation.pdf

[2] McNamee, L.M., Walsh, M.J., Ledley, F.D. (2017) Timelines of translational science: From technology initiation to FDA approval. *PLOS ONE*. 12.5 e0177371. journals.plos.org/plosone/article?id=10.1371/journal.pone.0177371

[3] McNamee, L.M., Zheng, S., Salim, U., Cleary, E.G., Ledley, F.D. (2020) Drug development in biotechnology companies with IPOs from 1997-2016. *Clinical Therapeutics* https://www.clinicaltherapeutics.com/article/S0149-2918(20)30522-1/fulltext
Cleary, E.G., McNamee, L.M., DeBoer, S., Holden, J., Fitzgerald, L., Ledley, F.D. (2021) Comparing long-term value creation after biotech and non-biotech IPOs, 1997-2016. *PLOS ONE* journals.plos.org/plosone/article?id=10.1371/journal.pone.0243813

[4] Ledley, F.D., McCoy, S.S., Vaughan, G., Cleary, E.G. (2020) Profitability of Large Pharmaceutical Companies Compared with Other Large Public Companies. *Journal of the American Medical Association,* 323(9):834-843. doi:10.1001/jama.2020.0442 https://jamanetwork.com/journals/jama/article-abstract/2762308

- The number of NMEs in different disease categories does not correspond with World Health Organization (WHO) burden of disease metrics (Disability-Adjusted Life Years, US or global) (**Figure 2**).
- NIH funding for published research related to every one of the 356 NMEs approved by the FDA from 2010-2019 or their 219 biological targets.
- This body of literature comprised >2 million scientific publications, of which 424K cited funding from the NIH, with >90% of this research representing basic science on the drug target, rather than applied or translational research on the drug itself.

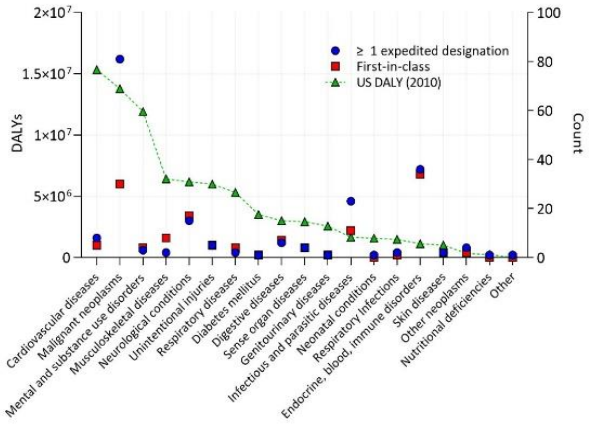

Figure 2. Number of NME approvals and US burden of disease across WHO disease classifications. Right axis: Number of first-in-class NME or NME having ≥1 expedited designations. Left axis: disability-adjusted life years (DALYs).

- NIH funding comprised 400K fiscal years of support and $180 billion in costs.
- Of the products listed in Orange Book (313), only 10.8% had a patent arising from this research. These patents were associated with <1% of the NIH funding.
- The 319 biotechnology companies completing IPOs from 1997-2016 raised $372 billion in net capital and generated >$100 billion growth in shareholder value (through 2016).
- The estimated probability of a biotechnology company having a product reach phase 3 trials was >70% and the estimated probability of having an approved product was >50%.
- From 2000-2018, 35 of the largest pharmaceutical companies reported $11.5 trillion of sales with gross profits of $1.9 trillion, distributing $1.7 trillion to shareholders in the form of dividends or stock buybacks, and funded $1.7 billion in R&D.

Questions raised by this work

- Can we meaningfully assess the innovativeness of new products coming to market and the health value created by these products?
- Do the expedited review pathways produce drugs with higher health value than conventional pathways? Can we meaningfully compare the health value with the economic value created by these pathways?
- Can we meaningfully assess whether new drugs coming to market address the unmet burdens of disease in the US or globally?
- By identifying and assigning quality metrics for the value of drugs, can we provide commentary on the seemingly disproportionate matching of innovation and metrics of unmet medical needs (such as DALYs)?
- Considering the public value arising from federally funded research to comprise health value along with economic gains (jobs, industrial output, GDP growth, taxes, license payments), can we meaningfully assess the public sector's return on investments in biomedical science?

Discussants

- **Tahir Amin, LLB (Hons), Dip LP** Co-Founder and Co-Executive Director, I-MAK. https://www.i-mak.org/people/tahir-amin/
- **Rena Conti, PhD** Institute for Health System Innovation & Policy, Boston University. https://www.bu.edu/ihsip/profile/rena-conti-phd/
- **Jonathan J. Darrow, SJD** Bentley University; Center for Bioethics, Harvard Medical School. https://faculty.bentley.edu/details.asp?uname=jdarrow https://bioethics.hms.harvard.edu/faculty-staff/jonathan-darrow
- **Frank Lichtenberg, PhD** Faculty of Business Economics, Columbia University. https://www8.gsb.columbia.edu/cbs-directory/detail/frl1
- **Kathleen L. Miller, PhD** Food and Drug Administration
- **Peter J. Neumann, ScD** Institute for Clinical Research and Health Policy Studies, Tufts Medical Center. https://www.tuftsmedicalcenter.org/physiciandirectory/peter-neumann

Workshop plan

The session will begin with an informal introduction to the theme of this workshop, followed by 5-8 minute comments from each discussant describing their perspectives based on their work and experience. We hope these introductory comments will provide an opportunity for an open discussion between the discussants and other participants in the workshop.

If you wish to ask a question during the session, please indicate yourself or directly post the question in the Zoom Chat box. A member of our team will be monitoring this and will invite you to ask your question at an appropriate time.

For more information, please email SciIndustry@bentley.edu.