

How to develop therapeutic and translational research collaborations with industry

Robin J. Kleiman* and Michael D. Ehlers*

Research and Development, Biogen, Cambridge, MA 02142

ABSTRACT Discovery and development of new medicines requires the talent and passion of both academic and industrial scientists. Identifying the optimal set of circumstances for direct collaboration between academic and industry teams requires a mutual understanding of what each partner brings to the relationship, and an appreciation of the specialized capabilities and scope of work to be undertaken by each group. We provide our perspective on the who, what, where, why, and how for establishing therapeutic and translational research collaborations between academic and industry scientists.

Monitoring Editor

William Bement
University of Wisconsin

Received: May 10, 2019

Revised: Aug 28, 2019

Accepted: Sep 5, 2019

INTRODUCTION

Converting discovery to drug is a long, laborious, and expensive undertaking. It requires teams with diverse expertise to methodically iterate through targets, pathways, and many doses, formulations, and variants of molecules, across a suite of preclinical testing to arrive at a candidate molecule suitable for clinical trials. Industry scientists frequently collaborate with academic laboratories to define and characterize the optimal molecular target, screening assays, and clinical development path for new molecules. Furthermore, industry invests substantial funding to support research into disease biology. A recent news article in *Science* highlighted several important trends from a National Science Foundation survey documenting changes in funding for basic research (Mervis, 2017). First, federal investments in basic research have plateaued while private investments in basic research by universities, philanthropy, and pharmaceutical companies have increased. As such, the proportion of funding for basic research coming from the federal government has dropped to 44% of the total U.S. investment in basic research. Second, drug company investments in basic research rose from \$3 billion in 2008 to \$8.1 billion in 2014 (Mervis, 2017). Funding academic research affords biotech and pharma companies access to novel target mechanisms and biomarkers that can enable new approaches to drug discovery.

Productive collaborations and partnerships between academic investigators and industry scientists require more than financial support for academic research programs. Industry partners have expertise and resources that can complement the focused scientific expertise of academic investigators interested in translating basic discoveries into new therapeutics. Key to the success of these partnerships is defining terms that enable investigators in each sphere to achieve success using the metrics that matter in academic and industry settings, respectively. Here, we provide some guiding principles based on our experience for considering the who, what, where, why and how, of building collaborations between academia and industry.

WHO IS WELL POSITIONED TO SHARE GOALS WITH INDUSTRY?

The expertise of investigators interested in collaborating with industry is the guiding principle for establishing a collaborative relationship. The types of deep scientific expertise that can impact a given company's portfolio can range from technology development to mechanistic disease area biology. Investigators who have developed an enabling technology with the potential to accelerate the drug discovery process are likely to find willing industry partners. Examples of enabling technologies include new or improved approaches to drug delivery, improved disease models with high translational value, and chemical biology approaches that enable focused mechanism of action studies for target molecules. Equally important are investigators who have disease expertise in an area of interest for a company. It is often important to identify qualified laboratories to conduct replication studies to confirm the results of a report from a single lab, or to conduct efficacy studies using disease models that a company may not have yet established in house.

Translational research is critically dependent on the expertise of clinicians who treat patients. Clinical investigators with access to

DOI: 10.1091/mbc.E19-05-0261

*Address correspondence to: Michael D. Ehlers (michael.ehlers@biogen.com); Robin J. Kleiman (robin.kleiman@biogen.com).

Abbreviation used: IND, investigational new drug.

© 2019 Kleiman and Ehlers. This article is distributed by The American Society for Cell Biology under license from the author(s). Two months after publication it is available to the public under an Attribution-Noncommercial-Share Alike 3.0 Unported Creative Commons License (<http://creativecommons.org/licenses/by-nc-sa/3.0>).

"ASCB®," "The American Society for Cell Biology®," and "Molecular Biology of the Cell®" are registered trademarks of The American Society for Cell Biology.

patient samples and insight into the development of outcome measures and biomarkers of clinical disease progression are vital partners for drug discovery programs. Investigators at academic medical centers with access to relevant clinical populations and institutional infrastructure can participate in clinical trials. Finally, senior investigators with both basic and translational expertise are often invited to join advisory boards to review a company's portfolio and provide input on the relative balance of risk and opportunity.

WHAT TYPE OF RESEARCH IS OPTIMAL FOR INDUSTRY SPONSORSHIP?

Industry programs value well-characterized preclinical models of diseases that have rigorous historical data including the characterization of "standard of care" molecules and other benchmarks. This is especially true of innovative and technically challenging models with high translational value. Technically challenging models are often more cost effective for an industry sponsor to establish with an academic collaborator to evaluate key molecules. Balancing the needs of the academic investigator to publish with the needs of the company to preserve intellectual property and proprietary data requires a mutual understanding of each collaborator's needs. A company will often sponsor testing of a set of molecules, which includes some benchmark molecule(s) that can be published right away, while also including a small number of molecules that will remain confidential for a predetermined period of time.

Industry will often fund investments in the development of key technologies that will enable accelerated advancement or expanded indication space for preexisting company assets. It is often important to the funding company to have access to intellectual property developed from the collaboration as a term for funding the research. Additionally, larger companies will fund research into mechanisms of diseases that are within their portfolio.

WHERE TO FIND OPPORTUNITIES TO COLLABORATE WITH INDUSTRY?

A common place to find industry partnerships is among public-private consortia that aim to solve a significant problem that has hampered the development of therapeutic approaches for a particular disease area. Consortia encourage competitor companies to pool resources to solve difficult challenges. This results in group development of a shared set of deliverables, such as biomarkers of disease progression or clinical outcome measures, while still allowing for competition to develop specific molecules. Academic partners are often invited to apply for grant funding to help support the contribution of data to the coordinated effort. The main requirement of these collaborative projects is typically that all the data be made available to all the consortia members for a limited period of exclusivity.

Industry innovation hubs have become a trend among biotech and pharmaceutical companies looking to survey a wide range of potential proposals from across the academic landscape. These hubs are typically staffed with veteran drug discovery scientists who have experience building screening funnels and assembly of investigational new drug (IND) packages. Large companies often embed these hubs in academic hotspots or establish umbrella partnerships with large academic institutions with prenegotiated terms for the codevelopment of molecules to target an academic hypothesis.

Project-specific sponsored research agreements are usually initiated by industry scientists who are responsible for leading

specific project teams in an industry setting. They are typically mapped out by a project team leader in need of targeted expertise to support the advancement of a specific program or technology platform.

WHY COLLABORATE WITH INDUSTRY?

There are a number of benefits to building collaborative relationships with industry sponsors that go beyond securing financial support for experiments. Industry-sponsored research is typically focused on a specific set of questions and can include a significant amount of in-kind contributions from discipline experts that may not be available at academic institutions. For example, industry collaborators can provide unique reagents and chemical tools, and conduct preclinical pharmacokinetic studies to support rational dosing paradigms or provide quantitation of drug levels in supported animal studies. Additionally, pharma or biotech collaborations can be a valuable career development opportunity for students and postdocs interested in exploring industry career paths. It can be difficult for trainees to develop a clear line of sight into industry science or relevant experience within academic departments. Collaborative projects with industry can provide trainees with valuable exposure to the drug discovery process and help establish critical networking opportunities for young scientists while they are training.

HOW DO INDUSTRY COLLABORATIONS DIFFER FROM GOVERNMENT- AND FOUNDATION-SPONSORED RESEARCH?

Metrics for success in academia and industry are different. Such differences can create cultural conflict between the need from academic investigators for publications and sustained funding with those of industry collaborators to make data-driven decisions about advancing or terminating a program of research. Even when academic and industrial collaborators are equally committed to helping patients, their perspective on the relative value of continuing a particular line of research can diverge. Industry collaboration agreements will typically include milestone-driven deliverables to ensure that the agreed upon body of work stays on track and is completed in a time frame that will be informative for the industry portfolio. Alignment between collaborators as to who will do what and when is critical to ensuring a successful collaboration. Regular meetings and a project team manager or leader is critical to successful collaborations between institutions.

Industry science emphasizes teamwork, which requires the expertise of many different discipline experts to be successful. This can run counter to the expectations of an individual investigator who builds a laboratory around a more focused expertise. The benefit of having industry collaborators is that they can provide additional perspectives as well as resources that may be difficult to fit into the confines of a National Institutes of Health (NIH) budget. Industry scientists often create a prioritized decision-making framework for finding solutions, which can enhance the impact of curiosity-driven research. Industry teams typically include professional statisticians to ensure optimal study design and analysis, and it is customary to include well-powered replication cohorts to verify reproducibility and robustness of results.

Industry will sometimes fund follow-up studies derived from basic research that may not be easily supported by government funding agencies because the work is not perceived as innovative enough to justify additional grant money. Replication studies and more detailed dose-exposure-response studies are a couple of examples in this category. This is particularly true when novel findings

are not yet sufficiently established to give industry scientists the confidence to invest internal resources on follow-up studies.

CLOSING THOUGHTS

There is no substitute for basic academic research driven by curiosity to explore novel areas of biology. It is not predictable, and it is never "completed." It is the lifeblood of advancing scientific knowledge and represents the most critical mission of research funding by foundations and government institutions to ensure that knowledge

advances. However, substantial financial and intellectual investment by industry scientists is required to convert basic research findings into medicines that benefit patients. Identifying and facilitating opportunities for academic and industry scientists to work together is essential to this process.

REFERENCE

Mervis J (2017). Data check: U.S. government share of basic research funding falls below 50%. *Science* 355, 1005.