PennState | CENTER FOR BIODEVICES

Creating Successful Multidisciplinary Collaborations Across Campuses

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Introduction:

The Center for Biodevices at Pennsylvania State University aims to bridge foundational science and clinical applications of biodevices, while enabling success of faculty, clinicians, and students across multiple disciplines. As part of its Outcomes Day on September 23, 2021, the Center organized a panel discussion on creating successful multidisciplinary collaborations across campuses. Subsequently, Center leadership prepared the following recommendations, based in part on the panel discussion.

Appreciate differences in training: Engineering, scientific, and clinical faculty typically come from much different training backgrounds and experiences. Engineering faculty may be more accustomed to milestone-driven technical research, whereas scientific faculty often perform hypothesis-driven research. Engineering faculty may be more familiar with NSF- and DoD-sponsored projects, whereas scientific and clinical faculty may aim for NIH funding. Some faculty bring critical clinical knowledge to the table, but may not have written a major grant application before. Successful collaborations harness the team's combined expertise. For example, a biodevices grant application with both technical and hypothesis-driven elements can be attractive to NIH's bioengineering (NIBIB) institute. Inclusion of a clinician on a project is often an expectation for NIH funding, and a clinician's active engagement can help optimize the direction and translation of the research toward helping patients.

Appreciate differences in job responsibilities: Engineering, scientific, and clinical faculty have different job responsibilities and criteria for success and promotion. Faculty may have significant teaching responsibilities in the classroom or with graduate students. Clinical faculty may have patient-related responsibilities that require 60 or more hours per week, and their schedule may change with little notice. Flexibility and patience are useful, and a clinician may not be able to dedicate as many hours on a research project compared with non-clinical faculty. At Penn State, for engineering and scientific faculty in tenure line positions, promotion is based largely on excellence in research and teaching. Clinicians should appreciate that for these faculty, obtaining significant federal funding can make (or break) their career, and thus should be the eventual goal of most cross-campus pilot projects. For clinical faculty, promotion is typically based on excellence in research *or* teaching, in addition to excellent patient care. At the College of Medicine, some basic science faculty have less classroom teaching responsibilities than their counterparts at University Park, but may be expected to have more grant funding and publications.

Build the connection: Penn State University faculty represent a remarkable breadth of research expertise, meaning that there is great potential for finding the right collaborator for multidisciplinary research. Ideal collaborators will be passionate about the research, and bring synergistic, complementary expertise. Initial connections with collaborators may occur through a variety of different circumstances, including networking events, such as those held by the Center for Biodevices. Early in a collaboration, it is important to build rapport with one another, ideally

through in-person discussions. Faculty gain an understanding of each other's goals, backgrounds, and constraints, and look at the potential project through the lens of the other collaborators. Nonclinical faculty can observe in the clinic or operating room, and clinical faculty can visit the collaborator's lab. The majority of cross-campus meetings can effectively use Zoom or Teams. Committing to routine meetings, e.g. biweekly or monthly, can help ensure progress.

Speak the same language, but avoid jargon: Multidisciplinary collaborations often have the major challenge of different vocabularies, and in a deeper sense, different foundational concepts between disciplines. In some collaborations with a clear separation of tasks, it is not prudent or necessary for the collaborators to learn each other's language. But many multidisciplinary projects integrate multiple expertise within each project aim, and most successful collaborative projects require extensive communication. A researcher may not be able to effectively help steer multi-disciplinary projects without a basic understanding of the disciplines involved. During meetings among collaborators, especially early in a project, jargon should be avoided as much as possible to keep everyone on the same page. In addition to moving the project forward, these meetings offer the best educational opportunities to gain understanding in one another's disciplines.

Apply for funding early: Internal and external grant applications not only have the potential for important funding, they also provide an excellent opportunity to define research objectives, and create a potential roadmap for project execution. Because multidisciplinary projects fall outside of traditional research fields, initially they may be ill-defined and have many potential paths. Literature reviews in support of proposals help define knowledge gaps and research direction. Hypotheses, development milestones, experimental design and statistical considerations help investigators understand feasibility of potential research paths. Many cutting-edge research areas lie at the intersection of disciplines; thus many internal and external funding opportunities specifically are designed for multidisciplinary research. Internal seed grants can provide important funds for collecting preliminary data to support a larger application. However, early and often, researchers should also consider applying to external foundations, industry, and/or governmental agencies. Targeting external funding sources, especially governmental, is highly valued by the University, and provides investigators with a better understanding of big picture potential of their research direction. Receiving substantial external funding is usually the key to transform the research from a small individual project, to a long-term research program. In the absence of pilot project funding, depending on the project, collaborators may be able to gather other preliminary data from their individual labs to provide enough support for a large external application. For both internal and external proposals, unfunded proposals usually receive written reviews that provide valuable feedback to the investigators.

Be open and honest: Collaborations among faculty can sometimes involve differences in opinion related to scientific decisions, project leadership, use of funds, credit on grant proposals, authorship order, etc. Issues are easier to resolve by close collaborators with mutual respect who are willing to compromise. An environment should be created in which investigators feel that they can share their opinions and expectations, early in the project and on a continual basis. In collaborations with a clear single principle investigator, leadership is simplified with the principle investigator usually entrusted to make final decisions. However, a multiple PI structure may be advantageous for some multidisciplinary collaborations. The NIH, as well as some internal PSU opportunities such as the Grace Woodward grants for collaboration in Engineering and Medicine, encourage or require multi-principle investigator proposals in which leadership is equally shared. A multi-PI plan, included in NIH proposals, lays out how decisions are made; for example, leadership over individual aims and subaims may be assigned to different PIs based on their expertise.

Be willing to pivot: Multidisciplinary collaborations bring new perspectives that may challenge the direction a project is going, or even its fundamental purpose. A change in project direction may seem difficult and inefficient at first, but in the long term could open up much greater possibilities for impact and funding. For example, an engineering faculty developing new simulation technology may have an initial goal of preoperative planning; but a clinician realizes that similar research could have a greater ultimate impact on medical education. (At Penn State there are two similar stories that led to successful NIH R01 grants!) A clinician who wants to show benefits of a new device concept may want to do a computational modeling study, but an engineer who understands the limitations or complexities of the particular modeling may identify a more convincing experimental test.

Be persistent: As the project evolves, investigators should seek out feedback and criticism from internal and external sources. A collaboration is not always successful, and it is better to fail early than to fail late. But if investigators maintain a thoughtful passion about the research, along with determination and discipline, persistence can often pay off.

Take advantage of Penn State resources: Penn State provides a variety of valuable resources for facilitating new collaborations and successful multidisciplinary research. The Penn State Center for Biodevices organizes two annual networking events and a seminar series, both intended to foster new research collaborations in the area of biodevices. The Center for Medical Innovation provides valuable resources related to intellectual property, industry engagement, and commercialization. The office of Research Development at the College of Medicine provides individualized consultations to help identify collaborators and funding opportunities. It also provides training opportunities and proposal resources. For example one program that leverages the value of observation and building the collaborative relationship is the Stimulating Partnerships Among Researchers and Clinicians (SPARC): Proposal for a Clinical-Research Exchange Fellowship (SPARC) funded by a University Strategic Initiative Seed Grant.