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ABRF Survey Outlines Need for Core Facilities' Leadership in Research Reliability

Scientists and core facilities providers require greater education and support in order to enhance implementation of scientific research transparency and rigor, according to the “Survey on Scientific Shared Resource Rigor and Reproducibility.” The article was published July 25, 2019, in the *Journal of Biomolecular Techniques* and authored by Kevin L. Knudtson, Robert H. Carnahan, Rebecca L. Hegstad-Davies, Nancy C. Fisher, Belynda Hicks, Peter A. Lopez, Susan M. Meyn, Sheenah M. Mische, Frances Weis-Garcia, Lisa D. White and Katia Sol-Church.

The publication is the official journal of the Association of Biomedical Resource Facilities (ABRF), an organization made up of over 700 members that work in or in support of resource and research biotechnology labs. ABRF members represent over 340 labs and offices in various sectors, including academia, government and industry.

The survey aimed to analyze how shared resource facilities are supporting investigators with transparency and rigor in their research. The survey also assesses the issues faced by shared resource staff and the assistance they need to better implement scientific rigor, reproducibility and transparency.

Issues with reproducibility have been a topic that researchers have long worked to address, with numerous federal agencies, nonprofit groups and research institutions developing initiatives to enhance reproducibility and transparency in scientific research. In 2015, the NIH released a set of guidelines outlining four elements of rigor (rigor of the prior research; rigor of the proposed research, or scientific rigor; consideration of biological variables; and authentication of key chemical/biological resources). The NIH defined scientific rigor as “the strict application of the scientific method to ensure unbiased and well-controlled experimental design, methodology, analysis, interpretation and reporting of results.”

To implement these guidelines, beginning January 25, 2019, NIH application instructions and review criteria for research grants and mentored career development awards replaced the phrase “scientific premise” with “rigor of the prior research.” Applicants are now required to not only explain their research plans, but also address possible flaws and weaknesses in the rigor of prior research. In 2017, the NIH implemented plans to “require formal instruction in rigorous experimental design and transparency to enhance reproducibility for institutional training, institutional career development, and individual fellowship applications.”

The “Survey” article from the *Journal of Biomolecular Techniques* is based on an 18-question online survey conducted by the ABRF Committee on Core Rigor and Reproducibility, which was established to implement rigorous and reproducible research through shared scientific resources. The survey was open from February 2017 to April 2017, and, according to the “Survey Demographics” section, was taken by 243 respondents from 21 countries. Respondents work with a wide array of research

technologies, including antibody development, bioinformatics, cell culture, chemistry, electron microscopy, genomics, NMR and proteomics.

While the majority of respondents indicated they were aware of the NIH's guidelines on rigor and reproducibility, many respondents noted significant challenges of doing reproducible research for certain projects. These included generating reproducible results that have a direct connection with the quality of the samples they are provided and work with, which can contribute to preanalytical error, as well as a lack of strict protocols in experimental design.

Moreover, despite professional staff being able to understand and identify issues that affect research reproducibility and reliability, approximately 85% of respondents indicated that they are not currently involved in any efforts to address issues such as scientific rigor and reproducibility at their institutions. This is likely linked to the low priority that core lab customers place on rigor and reproducibility concerns, according to the "Survey" article. However, virtually all respondents of this survey section indicated that they use at least one tool to support research and reproducibility in daily core operations, such as documentation (QC, SOPs), and data management and archive procedures.

In a multiple-choice segment of the survey, most respondents chose "mandatory consultation between the core and investigator prior to rendering services" and "integration of standardized procedures for management of data, equipment, personnel, reagent, specimen, supplies, methods and environment" as the main solutions for enhancing or better facilitating research reproducibility best practices in their labs. The next most popular selections were "[greater access to] stringent method validation and documentation" and "industry-vetted best practice guidelines for core technology."

The article also notes repeated suggestions from respondents to allocate funds and time to core personnel to encourage education and communication as it relates to their work related to research reproducibility. Of survey respondents, 36% cited educational, technical and scientific workshops as being crucial, as well as required project consultations with principal investigators and their staff.

The article posits that, per the survey results, scientists and providers of core services require additional training, resources, staff, guidelines and overall support in order to facilitate and maintain best practices in their labs. By reducing the risks to research data, overall research quality, rigor and reproducibility can improve.

Researchers Describe Solutions

The article also describes "factors contributing to lack of compliance with [reproducible research] guidelines." One of the factors listed is "inappropriate experimental and analytical tools."

"Responses that fell into this category were associated with the use of reagents that were not at a certified level of quality, using instruments that have not been calibrated (or are no longer in calibration), and using cell lines and antibodies that have not been validated," explained Kevin L. Knudtson, PhD, director of the Iowa Institute of Human Genetics Genomics Division at the University of Iowa and the lead author of the "Survey" article. "Also, some respondents commented on the

inability of some data management systems to capture important experimental metadata that would have been important for the analysis.”

As Dr. Knudtson told *IBO*, addressing issues that contribute to poor rigor and reproducibility in research will not be solved by any one sector in particular, as it requires a team effort, with analytical instrument companies being able to contribute to solutions through optimized educational protocols. “One of the main conclusions of our survey was that cores should be part of the educational process in working with investigators to help them design, execute and analyze experiments, especially as they apply to work performed at their cores,” he said. “Companies can address this issue by also being part of the educational process to include best practices, sources of variation, limitations, etc., when using their products.”

Cores are vital to providing education and support to investigators, as Dr. Knudtson indicated, and thus help accelerate innovation in research. Susan Meyn, director for Research Resources & Strategy at Vanderbilt University Medical Center (VUMC), and also an author of the “Survey” article, told *IBO*, “At VUMC, we agree with ABRF that research cores and shared resources have an institutional role in supporting researchers in the responsible conduct of research through training, informal mentorship and technical services provided by each core.” VUMC has demonstrated this through its actions, she said. “Our >60 core labs are particularly well suited to facilitating good experimental design and validated methods; providing authentication services for key biological and/or chemical resources; and in defining and establishing rigorous methods for acquiring and analyzing large, complex experimental data sets.”

Ms. Meyn described VUMC’s progress in addressing reproducibility issues. “Following the survey, we established a working group of core directors to draft guidelines for VUMC cores to enhance their role in enabling intellectual and scholarly rigor, transparency and reproducibility in science and practice,” she explained. “We hope to roll these out soon, and plan to use them as a springboard for several related areas of focus, for example data management and methods development.”

This action plan is similar to those of other labs, such as the University of North Carolina at Chapel Hill (UNC). According to “Survey” article author Nancy C. Fisher, PhD, director of the UNC Flow Cytometry Core Facility, as well as assistant director of Core Development and professor of Microbiology and Immunology at UNC, UNC’s approach resembles VUMC’s. “Through our Office of Research Technologies, we convened a Task Force on Rigor and Reproducibility in Core Facilities,” said Dr. Fisher. “We took the key points from the survey to create a ‘Best Practices’ list as a guide for core facilities at UNC. Core directors are also developing more specific guidelines for users of their individual cores, such as what I assembled for the Flow Cytometry Core Facility, which I direct.” Dr. Fisher worked on the Guide to Rigor and Reproducibility for Flow Cytometry Experiments, available on the UNC Department of Microbiology and Immunology’s website. The Guide outlines eight steps for ensuring rigorous and reproducible experiments in biomolecular research, as well as a list of rules researchers can consult for guidance.

As Dr. Knudtson, Ms. Meyn and Dr. Fisher all intimated, education by core labs is a key factor in improving rigor and reproducibility and related issues. “As [Ms. Meyn] mentioned, the directives of Research Core Facilities are now encompassing more than just access to technology,” stated Dr. Fisher. “We now take pride in having a major education focus for users of the technology to

maintain the highest quality and integrity of data generated for the biomedical research labs we serve. This is part of the mission of ABRF.”