Freedman and Inglese (1) provided an excellent synopsis of the causes for irreproducibility in cancer research and the need for standards, complementing previous concerns on this issue (2). In addition to recommendations provided by these articles, there are some tangible next steps that should be considered to improve the standards in basic biologic research.

1. Focused forums by organizations such as the American Association for Cancer Research (AACR) to discuss how to take the lead to improve reproducibility of data.
2. Aspects of quality standards such as FDA Good Laboratory Practice (3). For example, prospectively designed protocols, appropriate reagent labeling/expiry dates, continuous compulsory training, independent cross-checking/verification of data and preparation of key reagents (e.g., drugs), and appropriate archiving of raw data.
3. Statistical standards are needed via a guidance document, e.g., parametric versus nonparametric analyses, use of OECD 116 guidance document on design of toxicology studies as a template. Could AACR take the lead and publish a paper on the topic or include guidance in Instructions for Authors?
4. Access to raw data for published articles (in PDF/Excel) for a limited time online to embrace transparency.
5. Metrics to be revised for career advancement, publications, grants. Is there a team-based metric available?
6. Training. New PhDs receive 2 to 3 months learning basic techniques, statistics, etc. Consider a quality system approach, e.g., three levels of training for each technique (observation, competent with supervision/assistance, competent/independent).
7. Agreements between collaborators to include a requirement that each party receives access to copies of raw data generated in the project.

In relation to standards, the research community needs to be realistic about what is achievable and who will take responsibility for the implementation and monitoring in individual laboratories to enhance the quality of data. Despite some academic institutions moving to introduce GLP (4), for most research institutes this is unaffordable (not only in terms of cost but also in time and expertise/resources) and could stifle innovation and the creativity so valuable in basic biologic research. However, there are aspects of GLP and statistics worth considering to improve standards but points 1 to 4 need to be addressed by grant funding bodies, organizations, and/or publishers before academic groups or individual researchers will be motivated to implement points 2 to 7 within their laboratories. To achieve this, a cultural change is likely required, even beyond those challenges described in Clifton Leaf’s *The Truth in Small Doses* (5). Nevertheless, the implementation of some initial steps at organizational levels has the potential to transform aspects of the culture, which in turn will increase standards in basic biologic research.

**Disclosure of Potential Conflicts of Interest**

K. Dredge is Director of Drug Development at Progen Pharmaceuticals Ltd.

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References

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Keith Dredge


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