

Microphysiological Systems (MPS) for 3Rs, Scientific, and Regulatory Use

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1. Introduction

Microphysiological systems (MPS)—advanced in vitro models like organoids or organ-on-a-chip models—can support the 3Rs of animal research (Replacement, Reduction, and Refinement of animal use), scientific research, and regulatory aims. The United States non-profit, The 3Rs Collaborative advances the use of MPS as part of its broader strategy to advance better science – for both people and animals – through collaborative 3Rs approaches. They run an MPS Initiative, which includes commercial developers, end-users, and regulators.

2. Body

Microphysiological systems (MPS) are advanced in vitro models that replicate key aspects of human and animal physiology using engineered, multicellular structures. These systems go beyond traditional two-dimensional cell cultures by incorporating features such as 3D architecture, dynamic fluid flow, and tissue-specific functions. Examples include organ-on-a-chip devices, spheroids, organoids, and bioprinted tissues.

MPS are currently used in scientific research to study disease mechanisms, evaluate drug efficacy and toxicity, and model human biological responses in a controlled environment. Currently, they are especially used in basic research and discovery to help guide decision making such as in early screening to decide which drugs to proceed with in the clinical process.

MPS contribute to the Three Rs in several ways. They can fully or partially replace animal certain animal tests by providing human-relevant data in research, especially in areas where animal models have gaps. They could support reduction by improving experimental design and decreasing the number of animals needed while maintaining data quality. Although less direct, MPS could aid refinement such as by optimizing dosing strategies before animal studies begin to decrease animal stress and pain in projects.

In regulatory science, MPS are already being used in case by case applications with examples especially related to expanding application of previously approved therapies. Their broader adoption, however, hinges on building confidence and reliability in these platforms, as well as clearly defining “Contexts of Use” which are specific applications that outline how and where MPS data can be reliably used.

3. Conclusion

Ultimately, I encourage a balanced, rationale, and positive approach to new technologies like MPS. MPS should be considered one of the many scientific tools available to conduct science. More is needed to use them to their full potential. By working together, stakeholders can ensure that MPS fulfill their potential to advance both science and animal welfare.

References

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