

Alternative to Animal Testing: the now, the new and the next

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The NOW: Despite growing discomfort and doubt in its scientific value, animal testing remains the dominant technology in toxicology, with some replacements by rather simple cell cultures.

The NEW: The advent of stem cells and bioengineering has made human microphysiological systems (MPS) available, which replicate aspects of organ architecture and function. They are ready for validation, but we have to adopt quality assurance and reporting as well as the validation process.

The NEXT: The synergy of data generation and improvement of computers and algorithms has increased the power of AI more than billion-fold since AI was coined in 1956: Data in the world double every 18 months, i.e., 90% of all data were produced in last three years; computer double in capacity every 24 months (Moore's law) and AI algorithms double in capacity every 3 months since 2010. For most human skill tests, AI performs better than 90% of us. For toxicology and safety pharmacology, AI promises support for data retrieval, evidence integration (systematic reviews, risk assessments), predictive toxicology of untested compounds, digital pathology and support in reporting. The prospects of animal replacement with better accuracy in (human) prediction, ethical benefits and cost-effectiveness are enormous. Beyond this, accelerated assessments with automated data analyses, real-time monitoring and complex analyses come into reach with user-friendly prediction tools. These changes also promise to democratize knowledge, encourage open-access databases, algorithms and publications. As a copilot for toxicology, it empowers researchers, regulators, consumers and industry.

Combining brain MPS with AI, the new field of Organoid Intelligence (OI) was created, which seeks to establish learning and memory in a dish, with the obvious opportunities to cover with these functional endpoints some of the most complex neurological hazards.

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