



sion, the industry representatives showed great interest in what had been developed in the project. They outlined possible areas of application for implementing the models and identified some critical issues in the technological transfer to the companies, providing some useful suggestions. Our hope is that the promising dialogue between research and industry initiated by the BIOSQIN project will continue beyond the project's conclusion.

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Meeting Report

Micro-Replace Systems

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Event Overview

The successful R2N (Replace and Reduce from Lower Saxony) "Micro-replace systems" project funded by the Lower Saxony Ministry of Science and Culture in Germany focuses on developing complex microphysiological replacement systems for basic research in infection and inflammation. Based on that topic, the project consortium hosted a 3R Camp in Kiel, Germany from April 23 to 25, 2024. Prof. Dr André Bleich (Director of the Central Animal Facility and Institute for Animal Sciences, Medical School Hannover) and Prof. Dr Maren von Köckritz-Blickwede (Institute of Biochemistry and Research Center for Emerging Infections and Zoonoses, University of Veterinary Medicine Hannover) chaired the event.

Keynote addresses

The meeting began with a keynote address by Prof. Dr André Bleich, who emphasized the growing demand for animal-free experimental models, highlighting advancements in the digestive tract, respiratory tract, stem cell-derived and iPSC-derived models. Following this, Prof. Dr Maren von Köckritz-Blickwede discussed the importance of physiological oxygen levels and hy-

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poxia in alternative models and the development of animal-free antibodies.

Scientific presentations and discussions

Besides scientific talks of several invited international guest speakers, the event featured collaborative work from twelve working groups from the Medical School Hannover, the University of Veterinary Medicine Hannover, and the Technical University of Braunschweig. These groups presented their progress through posters and engaged in scientific discussions with the advisory board and principal investigators.

Guest speakers

1. **Prof. Dr Thomas Hartung (Johns Hopkins Bloomberg School of Public Health and CAAT, USA)** delivered a captivating presentation on the concept of organoid intelligence (OI). He introduced OI as a fusion of microphysiological systems (MPS), sensors, and artificial intelligence (AI), highlighting the potential of brain organoids to control robots and engage in playing video games. Prof. Hartung explained how AI could serve as a valuable co-pilot in the field of toxicology, en-



- hancing the understanding of drug interactions within human microphysiological systems. His demonstration underscored the transformative power of combining new technologies in alternative methods for animal testing, positioning AI advancements as a revolutionary force in future scientific research.
2. **Prof. Dr Thomas Herget (Merck KGaA Darmstadt and TU Darmstadt)** presented on the challenges and progress in replacing animal-based test methods in life sciences and healthcare. He introduced the Merck approach of pragmatic thinking to arrive at an actionable roadmap for phasing out animal testing. This strategy involves categorizing all animal testing into three central aims: (1) to mature already existing alternatives, (2) to develop new alternatives with available concrete ideas, and (3) to develop new alternatives with high innovative potential. Prof. Herget highlighted advancements such as the Blazar[®] Rodent Panel for virus testing, which reduces biosafety turnaround time by up to 80% and minimizes animal testing through molecular-based technology. He also discussed the Aptegra[™] platform, which consolidates five assays and four technologies into one using next-generation sequencing, thereby reducing testing time by 66% and costs by 43% compared to traditional methods. The talk emphasized the importance of integrating *in vitro* and *in silico* approaches, leading to the development of virtual control groups (ViCoG) aimed at further reducing the need for animal testing.
 3. **Marlies Mürnseer (Life Sciences Biomedical, UPM Biomedical)** delivered an impressive presentation on “3R Approaches in Advanced 3D Cell Culture: Utilizing Nanofibrillated Cellulose Hydrogels for Applications from Organoid Culture through Bioprinting to Drug Screening.” She showcased how cellulose derived from birch wood can replace the use of animal materials and enhance cell cultures. Mürnseer highlighted GrowDex Hydrogel suitable for multiple assay types as a ready-to-use, temperature stable, HTS optimized alternative increasing reproducibility, cutting costs, and replacing animal-derived gels. Her presentation underscored the potential of nanofibrillated cellulose hydrogels in advancing 3D cell culture technologies, promoting more ethical and sustainable research practices.
 4. **Dr Silke Riegger (3R Center Tübingen Business Unit, Tübingen, Germany)** focused on “Empowering the Next Generation of Researchers: Integrating Novel Alternative Methods in Education and Training.” Her talk emphasized the importance of organ-on-chip technology as well as the necessity of training, education, and effective science communication. Dr Riegger highlighted the need to tailor information dissemination to specific target groups through appropriate platform formats and channels. She stressed the importance of developing innovative, human-relevant models for studying human (patho)physiology and the imperative of offering comprehensive education and training to foster a new generation of researchers capable of applying novel approach methodologies such as organ-on-chip systems.
 5. **Prof. Dr André Bleich** presented on “Severity Assessment in Animal-Based Research,” discussing the importance of refinement and accurate assessment of animal pain and suffering. He highlighted his ongoing research at the Medical School Hannover aimed at improving qualitative severity assessment through multiple parameters including technical advancement with electronic cages for group housing and the generation of novel quantitative validation methods. Prof. Bleich emphasized the criticality of refinement and validation in alternative research models, advocating for more humane and precise methods in animal research.
 6. **Prof. Dr Lars Lewejohann (Institute of Animal Welfare, FU Berlin, and BfR)** presented “Home-cage Based Testing: How to Bring the Test to the Animal and Not the Animal to the Experiment.” He demonstrated the significance of animal well-being for reliable test results, introducing a method where mice voluntarily participate in tests through a reward principle. Prof. Lewejohann highlighted how reduced handling, enriched housing, testing during active phases, and minimized human influence can yield prompt and accurate results of animal intelligence.
 7. **PD Dr Ulf Tölch (Berlin Institute of Health, Charité)** discussed “Reporting Quality in 3D Models to Investigate Viral Tropism in SARS-CoV-2,” emphasizing the reproducibility of methods through protocols and proper data publication. He proposed a 6R principle, incorporating robustness, registration, and reporting as essential scientific values. Dr Tölch’s talk highlighted the need for rigorous standards in methods and data reporting to enhance the reliability and transparency of scientific research.
 8. **Prof. Dr Helmuth Gehart (ETH Zürich)** delivered a presentation on “Adult Tissue Stem Cell Organoids – Versatile Tools for Basic Research and Precision Medicine.” He explored the diverse applications of adult tissue stem cell organoids, including tumoroids derived from tumor cells, which are invaluable in cancer research. Prof. Gehart’s research aims to pave the way for patient-specific treatment modalities, with tumoroids playing a crucial role in drug development.
 9. **Dr Madalena Cipriano (μOrgano-Lab & 3R Center for In Vitro Models, Tübingen)** presented “Metabolism on-chip: Tailored Single and Multi-Organ-Chip Approaches.” She discussed the versatility of chip technologies adapted to various tissues to closely mimic *in vivo* conditions. Dr Cipriano highlighted the integration of human adipocytes, tissue resident immune cells, and endothelial cells from the same patient into the white-adipose tissue chip to study metabolic diseases, the integration of human liver microtissues into the liver-chip, the precise monitoring of insulin production by pancreatic microtissues on chip using oxygen sensors, and the use of heart-on-chip models for analyzing stimulation responses. Her presentation showcased the potential of these innovative approaches in advancing metabolic research and drug development while reducing reliance on animal testing.



10. **Dr Janna Nawroth (Helmholtz Pioneer Campus, Munich)** delivered a lecture titled “Defining ‘Organotypic’: Quantitative Benchmarks of *In Vitro* Human Airway Models.” She delved into the intricate structural and functional dynamics of mucociliary clearance within the human airway. Dr Nawroth’s research focuses on developing organotypic lung models that closely mimic the complexity of human lung tissue *in vitro*. She highlighted the importance of comparing human and rat lung models to establish quantitative benchmarks for evaluating the fidelity of *in vitro* human airway models, advancing respiratory research and drug development.

Workshops and networking

The event included a city rally for networking and team building, and a workshop for PhD students on “Self-presentation in academia.” Participants received training in short pitches and presentations. The camp concluded with a poster award ceremony, recognizing Maura Lynch-Miller (Research Group Infection Bio-

chemistry, University of Veterinary Medicine Hannover) for her work on microfluidic 3D cell culture systems to study lung infection and inflammation under pathophysiological oxygen levels.

Conclusion

We extend our gratitude to the organizers, particularly Dorothea Mühe, as well as to the speakers and participants for an enriching and fruitful three days of scientific discussions on alternatives to animal experiments.

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Meeting Report

National Workshop on Alternatives to Higher Animals in Toxicology and Biomedical Science

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The Indian Society for Alternatives to Animal Experiments (SAAE-I) organized a national workshop titled “*Alternatives to Higher Animals in Toxicology and Biomedical Science*” on November 22 to 29, 2023 at the Department of Zoology, Aligarh Muslim University, Aligarh (UP). Dr Yasir Hasan Siddique, Professor of Zoology, was the Organizing Secretary. There were 26 participants, including postgraduate students and research scholars.

Less sentient animals, which do not evoke ethical issues and are not protected by animal welfare legislation, are alternatives to mammalian models for research such as rodents. Ideally, they are easily accessible, plentiful, have a simple body plan and short life cycle, are easy to maintain and not expensive. Classic examples include *Hydra*, *Drosophila*, and *Caenorhabditis*. They can be used, e.g., to model human diseases and investigate potential treatments (Akbarsha et al., 2013; Patwardhan and Ghaskadbi, 2013; Ghaskadbi, 2020; Siddique et al., 2014, 2015, 2022) or as a bio-indicator of aquatic pollution (Prasad and Mookerjee, 1986; Zeeshan et al., 2016, 2017; Murugadas et al., 2016, 2019). The workshop was aimed at motivating the participants towards research using these organisms as models, as well as at developing laboratory skills. The

program included scientific lectures and laboratory exercises.

In his welcome address, the Organizing Chairman, Prof. **Mukhtar Ahmad Khan** (Chairperson, Department of Zoology), highlighted the relevance of the workshop and emphasized the value of the models. Prof. **Qudsia Tahseen**, Organizing Co-chairperson, deliberated upon the increasing use of invertebrate models such as *Caenorhabditis elegans*, *Drosophila*, and *Hydra* in biological research. She appreciated the effort to train the students in their use. Prof. **Mohammad Afzal** (Patron; Dean, Faculty of Life Sciences) appreciated the tremendous effort in organizing a much-needed workshop on research techniques. He briefly highlighted the achievements of the members and scholars of the Faculty of Life Sciences in general and the Department of Zoology in particular. Chief Guest, Prof. **Mohammad A. Akbarsha** (Founder of MGDC at Bharathidasan University, Tiruchirappalli, India, and Gandhi-Gruber-Doerenkamp Chair of Doerenkamp-Zbinden Foundation, Switzerland) appreciated the initiative taken by the organizers of the workshop for training the participants and highlighted the importance of using alternatives to higher animals in biological, toxicological, and medical research.