

Preclinical translational research study

- Cellular and Molecular Interactions in CNS Injury: The Role of Immune Cells and Inflammatory Responses in Damage and Repair
- Ultrasound-induced blood-brain barrier opening and selenium-nanoparticle injection lower seizure activity: A mouse model of temporal lobe epilepsy
- Role of gut microbiota in bempedoic acid against hyperlipidemia: a new candidate target for bempedoic acid on the therapeutic regulation
- Sexually Dimorphic Responses Reveal Multifaceted Benefits of Glibenclamide in Traumatic Brain Injury
- Mitochondrial Transplantation: A Novel Therapeutic Approach for Treating Diseases
- In vitro and In vivo Studies on Mesenchymal Stem Cells for Ischemic Stroke Therapy: A Scoping Review of The Therapeutic Effect
- Preclinical Insights Into the Effects of Frequency and Pulse Width on Evoked Compound Action Potential Morphology During Spinal Cord Stimulation
- Blood-brain barrier alterations as an initiator of brain metastasis from lung cancer: a new take on an old story

A preclinical [translational research study](#) bridges the gap between basic scientific discoveries and their application in clinical settings. It focuses on validating new therapies, drugs, medical devices, or interventions in laboratory and animal models before advancing to human clinical trials.

Key Elements of a Preclinical Translational Research Study: Objective:

To evaluate the safety, efficacy, and mechanism of action of a new therapeutic approach before human trials. Model Selection:

In vitro (cell cultures, organoids) and/or in vivo (animal models) systems that best mimic human disease. Experimental Design:

Defining study endpoints (biological, functional, or behavioral effects). Randomization and blinding to reduce bias. Dose-response studies to determine optimal dosing. Outcome Measures:

Biomarkers, imaging, histopathology, molecular analysis. Functional or behavioral assessments in animal models. Regulatory Compliance:

Adherence to Good Laboratory Practice (GLP). Ethical approvals (IACUC for animal studies). Toxicology studies to assess safety. Translation to Clinical Applications:

Identifying potential human applications. Refining protocols for first-in-human trials.

Translational [research](#) – often used interchangeably with translational medicine or translational science or bench to bedside – is an effort to build on basic scientific research to create new therapies, medical procedures, or diagnostics. Basic biomedical research is based on studies of diseases processes using for example [cell cultures](#) or [animal models](#).

The term translational refers to the “translation” of basic scientific findings in a laboratory setting into potential treatments for disease.

Surgeon-scientists are an essential component of the field of academic surgery, contributing to the fundamental understanding of disease and the discovery of innovative therapies. Despite this recognized value, the current landscape of academic medicine presents significant barriers to establishing and maintaining a successful career as a surgeon performing basic/translational research.

Peng et al. developed a fast, efficient, and complex [culture system](#) (IPTO, individualized patient [tumor organoids](#)) that accurately recapitulates the cellular and [molecular pathology](#) of human [brain tumors](#). Patient-derived tumor explants were cultured in [induced pluripotent stem cell](#) (iPSC)-derived cerebral organoids, thus enabling the [culture](#) of a wide range of human tumors in the central nervous system (CNS), including adult, pediatric, and [metastatic](#) brain cancers. Histopathological, genomic, epigenomic, and single-cell RNA sequencing (scRNA-seq) analyses demonstrated that the IPTO model recapitulates cellular heterogeneity and molecular features of original tumors. Crucially, they showed that the IPTO model predicts patient-specific drug responses, including [resistance](#) mechanisms, in a prospective patient cohort. Collectively, the IPTO model represents a breakthrough in the preclinical modeling of human cancers, which provides a path toward [precision oncology](#) ¹⁾.

There is a significant decline in the proportion of academic surgeons who are pursuing basic science/translational research, which represents a potential threat to the very identity of the translational surgeon-scientist.

Based on published literature and expert opinion, the Basic Science Committee of the Society of University of Surgeons prepared a roadmap to encourage and guide the next generation of surgeon-scientists as they embark on their academic careers.

This roadmap highlights key elements to consider in choosing an initial job and the importance of identifying a team of committed mentors. Expectations and guidelines for the first several years in practice are offered.

With guidance and mentorship, aspiring surgeon scientists can overcome the challenges inherent in choosing this career path and sustain the important legacy of those before them ²⁾.

Limitations in [genetic stability](#) and recapitulating accurate physiological disease properties challenge the utility of patient-derived (PD) [cancer models](#) for reproducible and [translational research](#).

Uhlmann et al. genetically engineered a [portfolio](#) of [isogenic human-induced pluripotent stem cells](#) (hiPSCs) with different pan-[cancer](#) relevant [oncoprotein signatures](#) followed by differentiation into lineage-committed [progenitor cells](#). Characterization on molecular and biological level validated successful stable [genetic alterations](#) in [pluripotency](#) state as well as upon differentiation to prove the functionality of the approach. Meanwhile proposing core molecular networks possibly involved in early dysregulation of [stem cell homeostasis](#), the application of the cell systems in comparative substance testing indicates the potential for [cancer research](#) such as identification of augmented [therapy](#) resistance of [stem cells](#) in response to activation of distinct oncogenic [signatures](#) ³⁾.

Translational neuro-oncology research

Translational neuro-oncology research

1)

Peng T, Ma X, Hua W, Wang C, Chu Y, Sun M, Fermi V, Hamelmann S, Lindner K, Shao C, Zaman J, Tian W, Zhuo Y, Harim Y, Stöffler N, Hammann L, Xiao Q, Jin X, Warta R, Lotsch C, Zhuang X, Feng Y, Fu M, Zhang X, Zhang J, Xu H, Qiu F, Xie L, Zhang Y, Zhu W, Du Z, Salgueiro L, Schneider M, Eichhorn F, Lefevre A, Pusch S, Grinevich V, Ratliff M, Loges S, Bunse L, Sahm F, Xiang Y, Unterberg A, von Deimling A, Platten M, Herold-Mende C, Wu Y, Liu HK, Mao Y. Individualized patient tumor organoids faithfully preserve human [brain tumor ecosystems](#) and predict patient [response](#) to therapy. Cell Stem Cell. 2025 Feb 5:S1934-5909(25)00002-5. doi: 10.1016/j.stem.2025.01.002. Epub ahead of print. PMID: 39938519.

2)

Goldstein AM, Blair AB, Keswani SG, Gosain A, Morowitz M, Kuo J, Levine M, Ahuja N, Hackam DJ; Basic Science Committee of the Society of University Surgeons. A Roadmap for Aspiring Surgeon-Scientists in Today's Healthcare Environment. Ann Surg. 2018 Jun 28. doi: 10.1097/SLA.0000000000002840. [Epub ahead of print] PubMed PMID: 29958227.

3)

Uhlmann C, Nickel AC, Picard D, Rossi A, Li G, Hildebrandt B, Brockerhoff G, Bendt F, Hübenthal U, Hewera M, Steiger HJ, Wieczorek D, Perrakis A, Zhang W, Remke M, Koch K, Tigges J, Croner RS, Fritsche E, Kahlert UD. [Progenitor cells](#) derived from [gene-engineered](#) human induced [pluripotent stem cells](#) as synthetic cancer cell alternatives for [in vitro](#) pharmacology. Biotechnol J. 2022 Mar 25:e2100693. doi: 10.1002/biot.202100693. Epub ahead of print. PMID: 35334498.

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