

**Workshop 1: Data (interoperability, open science)**

**Workshop 2: Bioethics**

**Workshop 3: Translational Research**

**Workshop 4: Clinical & patient outreach for clinical decision support**



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# Workshop 1: Data (interoperability, open science)



Feb 24th

Chairs: Miguel Ángel González Ballester, Sai Natarajan

## Keynote 1: Prof. Dr. Raphael Sznitman

9:00-9:30

### Title: AI in Medicine at the University of Bern and a brief overview on AI-based precision medicine in ophthalmology

This talk will start by giving a broad overview of a new Center for AI in Medicine at the University of Bern that has mission of developing and validating AI methods with the potential of improving the quality-of-life of patients and rendering healthcare systems more efficient. We will then showcase some work in the context of ophthalmology, where chronic conditions play an enormous burden on patients and healthcare system. Specifically, we will discuss how machine learning methods focused on analyzing Optical Coherence Tomography (OCT) imaging can be used to not only identify and quantify known biomarkers linked to retinal pathologies, but broadly allow the identification of patients are likely to respond positively to envisioned therapeutic therapies.

*Prof. Dr. Raphael Sznitman is the director of the ARTORG Center for Biomedical Engineering Research and the director for the Center of Artificial Intelligence in Medicine at the University of Bern. After receiving a BSc in Cognitive Science from the University of British Columbia (Canada) and a PhD in Computer Science from Johns Hopkins University (USA), he spent time as a postdoctoral fellow at the EPFL (Switzerland) and then joined the medical faculty at the University of Bern in 2015. Today, he leads the Artificial Intelligence in Medical Imaging laboratory, where his research focuses on developing novel approaches in computer vision and machine learning for healthcare.*



Chairs: Aleksei Tulpin, Francis Chemorion

## Keynote 2: Prof. Dr. Stavroula Mougiakakou

9:45-10:15

### Title: AI-powered dietary assessment

The prevention of both onset and progression of diet-related acute and chronic diseases (e.g. diabetes, obesity, kidney disease) requires reliable and intuitive systems able to translate food intake into nutrient intake. Since 2008, we are developing technologies that harness the synergy of artificial intelligence and computer vision to make the dietary assessment real-time, accurate and more cost efficient than the conventional methods. Diabetes, compliance to a healthy diet, and hospitalised malnutrition are cases in which the analysis of simple meal photos or videos allows to decrypt information related to the nutrient content of the meal.

*Prof. Dr. Stavroula Mougiakakou is an Associate Professor affiliated with the Faculty of Medicine, University of Bern and holds a Ph.D. degree in electrical and computer engineering from the National Technical University of Athens. She is currently leading the AI in Health and Nutrition laboratory at the ARTORG Center for Biomedical Engineering Research Bern, Switzerland. Her research interests include artificial intelligence, machine learning, computer vision and their application in prevention, diagnosis, and treatment optimization of acute and chronic diseases. Over the last years she successfully involved herself and her research group in many competitive national, European, and internationally funded R&D projects, resulting in numerous publications, a number of patents and several technology transfer activities.*



Chairs: Jaro Karppinen, Dimitrios Lialios

## Keynote 3: Dr. Anne Mannion

11:00-11:30

### Title: The use of registry data in clinical research and to inform decision-making in spine surgery

A registry is a systematic collection of a clearly defined set of demographic and clinical data from patients with specific health or treatment characteristics, held in a central database for a predefined purpose. Some consider the data contained therein to be a gold mine that can be exploited for research purposes whereas others are sceptical of its potential, due to issues with compliance, accuracy of documentation and (especially in treatment interventions) attrition during follow-up. This talk will discuss some of these issues and describe an in-house spine registry that has been running since 2005 in the Schulthess Klinik, Zürich, using the framework of EUROSPINE's (Spine Society of Europe) "Spine Tango" registry. It utilises standardised forms for the collection of data describing the patient history, presentation and demographics, the surgical procedure, and complications arising during and after surgery, as well as Patient Reported Outcome Measures (PROMs) before surgery and at fixed follow-up intervals thereafter. The registry currently contains the data of >22'000 patients (spine surgeries).

*Dr. Anne Mannion is the Head of Spine Research at the Schulthess Klinik Zürich. After receiving her BSc (Hons) in Physiology and Zoology from the University of Sheffield (UK) and PhD in Muscle Physiology/Biochemistry from the University of Salford (UK), she had various postdoc positions at the University of Birmingham, School of Sport and Exercise Science (UK), the University of Bristol, Comparative Orthopaedic Research Unit (UK), and Queen's University, Dept Engineering (Kingston, Canada) before joining the Schulthess Klinik in 1996 and remaining there until the present day. In 2001 she was awarded the Venia Legendi (Privatdozentin) title from the University of Zürich, Faculty of Medicine (Rheumatology and Physical Medicine). She has 201 publications currently listed in Pubmed and an H-index of 56.*



Feb 24th

Chairs: Josep Lluís Gelpi, Paola Bermudez-Lekerika

### Keynote 1: PD Dr. Alessandra Bergadano

13:00-13:30

#### Title: Animal pain and ethic; a 360° tour

It has been a long journey from accepting that animals feel pain and have emotions related to it, which can result in suffering and that they need for appropriate treatment. Pain in (laboratory) animals can be (i) "clinical": secondary to vet treatment or injury or illness and (ii) "research related": an undesired by-product of a research model but pain can be the focus of the research itself. The harm-benefit analysis is mandatory when pain can be elicited in animals used in research and the regulatory and ethical frames are well defined. For ethical, moral, and scientific reasons pain must be kept to a minimum; pain relief is key to the internal validity of research. This addresses one of the interests of the animals "being free of pain and disease" and therefore their dignity. The aversiveness of pain in animals is primarily determined by duration and intensity: its alleviation typically means reducing its duration and/or its intensity, and both are refinements to be made whenever possible. Moving forwards in our understanding of animal welfare and pain states, it is important to include a structured ethical reflection and on where to set the bar for the sake of the animal. In research, setting endpoints is mandatory to avoid suffering but establishing a culture of care will help reduce pain and suffering in a reproducible manner. This is an overarching process which benefits from the continuing collegial discussion between the different stakeholders for the benefit of animal welfare. And the journey continues...

*PD Dr Alessandra Bergadano is a veterinarian by training and received her PhD degree in comparative models of nociception, pain diagnosis, and analgesia from the University of Aalborg in Denmark and the University of Bern in Switzerland. She is a European Specialist in both veterinary anesthesia and analgesia, as well as laboratory animal medicine. For over 15 years, she has been fully dedicated to lab animal medicine and since April 2022 she is the head of the Experimental Animal Center of the University of Bern. She has authored and co-authored over 30 peer reviewed papers. Her present work focuses on developing the "culture of care" at the University of Bern and in Switzerland. Currently, she is a board member of the exam ECLAM committee, and serves as ad hoc Consultant for AAALAC International.*



Chairs: Christine Le Maitre, Roger Compte Boixader

### Keynote 2: Dr. Catherine Le Visage

13:45-14:30

#### Title: IVD regenerative medicine: moving from animal models to clinical trials

The intervertebral disc (IVD), a fibro-cartilaginous structure acting as a natural shock absorber, contains an outer network of collagen fibres (Annulus fibrosus) surrounding a central gelatinous (Nucleus pulposus). Low back pain, affecting over 80% of adults during their lifetime and resulting in considerable disability and socioeconomic consequences, has been associated with IVD degeneration. On one hand, preclinical animal models of the disease have been considered to reproduce IVD degeneration and better understand its pathophysiology. They have proven useful in evaluating the efficacy of new therapeutic strategies and overcoming safety issues and ethical considerations prior to human clinical trials. On the other hand, ethical guidelines and concerns for animal welfare and care have led to the implementation of the three Rs (Replace, Reduce, Refine) principles and alternatives to animal experimentation are needed. In this talk, we will first provide an overview of the clinically relevant animal models of IVD degeneration that can provide insights into the degenerative process and be used for preclinical translational studies. We will then look at IVD specific alternative translational approaches to the classic in vivo approach. The implementation of ex vivo models and the design of bioprinted constructs recapitulating the complex architecture of an IVD could become an essential tool for data collection leading towards clinical trials, both human and veterinary ones.

*Dr. Catherine Le Visage is a Research Director and the Deputy Director of the Regenerative Medicine and Skeleton (RMeS) laboratory at the University of Nantes, France. She was trained as a Pharmacist, received her PhD in Pharmaceutical Technologies in Paris then performed a post-doctoral training in the BME Department of the Johns Hopkins University (Baltimore, USA) in Prof. K. Leong's laboratory with a focus on biomaterials for regenerative approaches. In 2007, she joined with a tenured position the French National Institute of Health and Medical Research (INSERM) to investigate chemically cross-linked polysaccharide hydrogels. As a group leader, her most recent works have focused on innovative hydrogels as i) carriers of cells or bioactive molecules in the context of IVD disease and osteoarthritis and ii) tools for stem cell-based organogenesis. She is an elected member of the TERMIS-EU Council (2018-2021), and has been appointed Chair of the communication committee. She is a member (2020-2022) of the Editorial Advisory Board of "ACS Applied Materials & Interfaces", and a reviewer for national and international funding agencies (Canada First Research Excellence Fund, European Science Foundation, L'Oreal/UNESCO). She has coauthored 73 publications (h-index 32) and 11 patents, and has given 60 invited lectures/seminars at national and international conferences*



# Workshop 3: Translational Research (Biomechanics)



Feb 24th

Chairs: Ludovic Humbert, Katherine Crump

## Keynote 1: Prof. Dr. Philippe Zysset

14:45-15:15

### Title: From Bone Micromechanics to Clinical Diagnostics

Bone is a multifunctional organ and multiscale composite with exceptional mechanical properties. However, bone fractures occur in trauma, fatigue, disease or simply as the result of ageing. The broad vision of the virtual physiological human includes the prediction of bone strength using computational methods and becomes reality with quantitative computed tomography at increasing resolution. This lecture will recall current knowledge on bone anatomy, mechanics and review recent technologies applied to the investigation of this intriguing tissue. Design and validation of finite element models for human bones will be presented with the resulting perspectives for fracture risk evaluation in a clinical environment.

*Prof. Dr. Philippe Zysset obtained a diploma in engineering physics and a PhD in biomechanics at the Swiss Federal Institute of Technology Lausanne (EPFL) in 1987 and 1994 respectively. After a postdoc in orthopedic research at the University of Michigan, he became an assistant professor in biomechanics at EPFL. In 2003, he was appointed professor of biomechanics at the Vienna University of Technology, where he founded a laboratory for nano- and micromechanics of biological tissues and promoted novel research activities in computational biomechanics. Since 2011, he is a professor of biomechanics at the University of Bern, continues his research in multiscale bone mechanics and heads a master program in biomedical engineering.*



Chairs: Jérôme Noailly, Terence McSweeney

## Keynote 2: Prof. Dr. Philippe Büchler

15:15-15:45

### Title: In-vivo Quantification of Spinal Stiffness of Adolescent Idiopathic Scoliosis Patients

Degenerative spine problems and spinal deformities have high socio-economic impacts. Current surgical treatment is based on bony fusion, which can limit mobility and function. Accurate descriptions of the biomechanics of normal, deformed, and degenerated spinal segments under in vivo conditions are needed to develop new approaches that preserve spinal function. Ex vivo testing on spinal loading simulators has been the almost exclusive standard for spinal biomechanical assessment and spinal stiffness analysis. While this method has improved the general understanding of normal spinal function and the consequences of induced injury, it is still an ex vivo experiment, and suitable spines from human cadavers are scarce. Most are taken from the cadavers of elderly people and rarely exhibit the desired pathology. In recent years, we have developed and applied methods to measure the mechanical properties of the spine in vivo. First, an instrumented forceps was combined with an optical tracking system to measure vertebral motion when load was applied. It was used intraoperatively to quantify segmental stiffness in scoliotic patients. Second, an axial suspension test has been proposed to assess preoperative spinal flexibility in patients with adolescent idiopathic scoliosis. Finally, based on this experience, a robotic system in under development to intraoperatively measures the three-dimensional segmental stiffness of patients' spine. In vivo stiffness measurements performed in the natural physiological environment can improve our understanding of spinal biomechanics in patients who have the pathology of interest, giving us information essential to developing new "non-fusion" implants.

*Prof. Dr. Philippe Büchler obtained his M.Sc. in physics from the école polytechnique fédérale de Lausanne, where he completed a Ph.D. in biomechanics on the numerical analysis of total shoulder replacements. After briefly working as a research scientist at the University Hospital in Geneva, he joined the University of Bern in 2004, where he is now Associate Professor leading the Computational Bioengineering group. His research focuses on the development of patient-specific models, combined with the in vivo characterization of the mechanical behavior of soft tissues.*



Feb 24th

Chairs: Leonidas Alexopoulos, Andrea Nüesch

## Keynote 3: Dr. Christoph Albers

16:30-17:00

### Title: Inhibition of BMP2-antagonists to improve spinal fusion

Spinal fusion surgery is one of the most frequent surgical interventions in spine surgery. Annually, more than two million procedures are executed worldwide. Spinal fusion is successful in many patients, however, lack of osseous fusion resulting in pseudo-arthritis, instability and ongoing pain requiring revision surgery is commonly faced. Aside from auto- and allograft, bone morphogenetic proteins (BMP) are employed to promote spinal fusion. Despite their use, non-fusion remains a problem. Moreover, an increasing body of evidence suggests its critical use due to adverse events and morbidities associated with their application at high concentrations. Previous study found that intervertebral disc (IVD) cells exhibit inhibitory effects on the maturation of bone forming osteoblasts in vitro. Furthermore, incomplete removal of IVD reportedly decreased fusion rates in clinical trials. It was therefore hypothesized that IVD cells counteract bone formation by the secretion of BMP antagonists. A promising approach would be to block the inhibitory effect of BMP antagonists thereby increasing spinal fusion rates while reducing the threshold for therapeutic concentrations of BMP. In this lecture, current clinical standards as well as needs and challenges related to spinal fusion will be discussed. Moreover, novel, preclinical strategies to improve spinal fusion will be presented.

*Dr. Christoph Albers is the Chief Consultant of Orthopaedic Surgery, Co-Head of Spine Surgery, and Head of Traumatology at the University Hospital Bern, Switzerland. For over 10 years, he has been dedicated to Orthopaedic Surgery and Traumatology and was recently awarded with the Venia Docendi (Habilitation) title from the University of Bern. He is involved in many international orthopedic and spine surgery societies including AOSpine, EuroSpine, Swiss Orthopaedics. He has published more than 60 original articles/reviews and is currently the Head of Translational Research Orthopaedic Surgery at the Swiss Institute for Translational and Entrepreneurial Medicine (SITEM).*



Chairs: Benjamin Gantenbein, Ahmad Alminnawi

## Keynote 4: Prof. Dr. Cecilia Persson (via ZOOM)

17:15-17:45

### Title: Low-modulus bone cement - from vertebroplasty to discoplasty

Low-modulus bone cements have been developed in an attempt to mitigate complications associated with vertebroplasty. Many fractures occurring after treatment are believed to be avoidable, through the use of less cement and/or a low-modulus cement, with properties better suited to the surrounding bone. Discoplasty, i.e. injection of cement into degenerated discs presenting vacuum phenomena, has recently been returned to as a possible solution for elderly patients suffering from comorbidities, as it presents a less invasive alternative. Here as well, a low-modulus cement may be beneficial. We have developed a low-modulus cement, currently under clinical evaluation for vertebroplasty. However, its potential benefits in discoplasty remain to be determined. Very few pre-clinical models are available to this end, and here I will report on results from a computational study, as well as the development of an experimental ovine model for future use in discoplasty evaluations. The translational process of the vertebroplasty cement will also be commented upon.

*Prof. Dr. Cecilia Persson is a Professor in Applied Materials Science at Uppsala University (<https://katalog.uu.se/profile/?id=N9-1332>) and the President of the Scandinavian Society of Biomaterials. She currently directs research networks within the field of biomaterials and devices for the spine (MSCA ITN NU-SPINE and EIT Health SOFTBONE), as well as a Competence Centre for Additive Manufacturing in the Life Sciences (<https://www.uu.se/en/research/am4life/>)*



Feb 25th

Chairs: Baldo Oliva, Francesco Gualdi

## Keynote 5: Dr. Roland Herzog

9:00-9:30

**Title:** Passion for translation

Translation of technology to a commercial partner and clinical application is the most direct way to improve patient care. Successful translation starts at the very beginning of a research project. Selecting the research area, thinking about clinical needs, and defining the specific claims of a new technology set the base for a clinical application. Understanding and respecting the framework of the healthcare system including regulatory guidelines is crucial to bring a technology to the patient's bed. Additional to the innovative concept, translation needs a good understanding of the environment the innovation has to prove itself in. The successful translator will not only translate technology to products, but he can also translate between engineers and physicians, between scientists and investors and create a common understanding of opportunities and challenges.

*Dr. Roland Herzog received his PhD degree in Physics and Dr. sc. nat in Biomechanics at the Eidgenössische Technische Hochschule (ETH) Zürich Switzerland and now he works at AO Foundation with 30 years of experience in medtech development, medtech marketing, innovation management and technology transfer in several international companies and organizations including Joint Replacement, Dental Implants and Trauma.*



Chairs: Simo Saarakkala, Exarchos Kanelis

## Keynote 6: Prof. Dr. Lorin Benneker

9:45-10:15

**Title:** Rupture of the annulus fibrosus – an unsolved problem! Update on clinical and translational solutions

Whereas degenerative changes of the nucleus pulposus usually are clinically asymptomatic, rupture of the annulus fibrosus (AF) often result in local pain and/or neurological symptoms in case of a disc herniation. In this lecture the pathogenesis of AF failure and its clinical symptoms will be discussed as well as treatment strategies from surgeons and researchers.

*Prof. Dr. Lorin Benneker works as a spine and trauma surgeon in Bern, Switzerland. His clinical work focuses on degenerative conditions of the spine, tumor and adult deformity as well as traumatic injuries of the spine and pelvis. He is an active researcher with more than 150 publications; basic research is focused on the regeneration of intervertebral discs, the clinical focus is the optimization of the surgical treatment in adult deformity, trauma and tumor patients. Prof Benneker is co-founder of Impedia which is a not-for profit platform with the goal to improve education of surgeons and increase safety in surgery by adapting non-technical skills from aviation. He is involved in many international orthopedic*



# Workshop 4: Clinical & patient outreach for clinical decision support

Feb 25th

Chairs: Jaro Karppinen, Estefano Muñoz

## Keynote 1: Prof. Dr. Sven Trelle

11:00-11:30

### Title: The role of the study protocol in clinical trials (as opposed to other research studies)

The clinical trial protocol is the central document in a clinical trial. I will discuss its function and show examples how strict or flexible it must be interpreted when conducting a clinical trial. I try to contrast this with (scientific) research in other disciplines.

*Prof. Dr. Sven Trelle is the director of the Clinical Trials Unit (CTU) Bern in the University of Bern. He received his Venia Docendi (Habilitation) title in Clinical Epidemiology and Biostatistics from the Medical Faculty of University of Bern. Since 2007, he has been a member of review panels on clinical research calls in the German Research Foundation and the German Federal Ministry of Education and Research. Similarly, he has been a member of data monitoring committees of various clinical trials including industry and investigator-initiated trials since 2015. He is an active researcher involved in randomized and non-randomized clinical trials, observational and diagnosis studies, grant applications, and regular consulting for clinical researchers on study design, statistical analysis and regulatory aspects.*



#### Conference Hosts

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