Title: SmILE - Supporting health care professionals, empowering patients and reducing the burden of musculoskeletal diseases via smart sensing implants and an AI-driven health platform.

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Abstract:
Musculoskeletal-non-communicable diseases (MSK-NCDs) affect the bones, joints, muscles and connective tissues. In the elderly population, the most common MSK disorders include osteoarthritis, rheumatoid arthritis, osteoporosis, and fragility fractures. They lead to chronic pain, loss of mobility, functional impairment, and loss of independence which substantially affect the quality of life and are correlated with the onset and progression of cardiovascular, oncological, neurological and mental diseases. Due to demographic ageing, Luxembourg and Europe are facing a major challenge for their healthcare systems, and societies to manage MSK diseases.

SmILE is a project funded by the Horizon Europe program bringing together 26 partners from 11 countries to develop smart solutions for earlier diagnosis and better long-term care of musculoskeletal diseases including rehabilitation after treatment. With AI-driven insights and a patient-centred approach, we aim to support health care professionals and empower older adults to take charge of their health and stay active for longer. This involves the use of wearable sensor technologies and in particular smart sensing implants such as fracture fixation devices (plates and nails for osteosynthesis) and joint replacements (total hip and knee arthroplasty) which can monitor the healing process, the post-operative activity and function during rehabilitation and other health related domains (e.g. inflammation or infection). We describe the SmILE's project objectives, approaches and targeted results, outcomes and impact including the Luxembourgish contributions and perspectives.

References

1) Smart Solutions for enhanced bone & joint health in an ageing population, https://www.horizon-smile.eu/

2) LIH Joins European Initiative to Develop Smart Solutions for Musculoskeletal Diseases, https://www.lih.lu/en/article/smile-project-launches-to-innovate-musculoskeletal-disease-management/

BIOSKETCH

Dr. Bernd Grimm

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CURRENT POSITION: *Group leader of the Human Motion, Orthopaedics, Sports Medicine and Digital Methods (HOSD) Platform, Luxembourg Institute of Health*

BIOSKETCH:

Dr. Grimm has dedicated his professional life to the translational interfaces of orthopaedic biomechanics, human movement and physical activity analysis, wearable devices and patient outcome assessment methods, includig digital tools, towards clinical application, validation and evidence in clinical trials.

Following his PhD in Biomedical Engineering and lectureship for Applied Mechanics at the University of Bath, UK Dr. Grimm set up and directed the AHORSE orthopaedic research foundation at the Zuyderland Medical Center, training hospital of Maastricht University, Netherlands. During this time Dr. Grimm has developed, as a pioneer in the field, wearable sensor applications for the measurement of human movement and physical activity with a focus on the clinical assessment of hip and knee surgery outcomes. These methods are now used by various international universities, have been the basis of several PhD thesis and topic of invited keynote lectures and symposia.

After working with the Human Motion Institute, affiliated with the Dept. Clinical Applications of Computational Medicine, TU Munich, Germany towards the development and validation of wearable devices and digital biomarkers as clinical trial endpoints, he has joined the Luxembourg Institute of Health (LIH) at the Department of Precision Health as a group leader.
His unit is operating partner with LIROMS (Luxembourg Institute of Research in Orthopedics, Sports Medicine and Science) of the hospital-based (CHL Eich) Human Motion Lab (HML) for patients and the national movement laboratory for athletes (SportFabrik, LIHPS) conducting research into mobility metrics towards improving patient outcomes, personalized rehabilitation and injury prevention.

Dr. Grimm is a Visiting Fellow at the University of Bath, UK and Honorary Research Fellow at the School of Clinical Science of the University of Bristol. Furthermore, Dr. Grimm serves as editorial board member for the “Journal of Translational Orthopaedics” (JOT) and Medicine in Novel Technologies and Devices (MEDNZD), and as Associate Editor for Basic Science at the “EFORT Open Reviews”, the main journal of the European Federation of National Associations of Orthopaedics and Traumatology”. He has been Past-President of the European Orthopaedic Research Society (EORS) and is President of ICORS, the International Combined Orthopaedic Research Societies (2022-2025).

Dr. José Pantaleón Hernández

CURRENT POSITION:

Senior Research Coordinator at the Human Motion, Orthopaedics, Sports Medicine and Digital Methods (HOSD) Platform, Luxembourg Institute of Health

BIOSKETCH:

Dr. José Pantaleón Hernández, is an epidemiologist and senior research professional with a strong record in academic leadership, public health, and clinical research. He earned both his Doctor of Philosophy (DPhil) and Master of Science in Health Research from the University of Oxford, at the Nuffield Department of Primary Health Care Sciences. Here his work in clinical epidemiology focused on evidence-based medicine and patient-centred interventions in primary care. After some postdoctoral work, he worked in various positions in Oxford both for University as a Project Manager and later in commissioning for the National Health Service (NHS).

Before joining his current institution, Dr. Hernández led a multidisciplinary research group at the International Clinical Research Centre in Brno, Czech Republic, coordinating international collaborations in cardiometabolic epidemiology with partners including the Mayo Clinic and McMaster University.
From 2020 to 2024, he served as Medical Lecturer and Assoc. Professor at EDU Medical University (Bratislava), where he taught medical students for four years, supervised over seventy medical theses, and contributed to curriculum development in clinical and research education.

Currently, Dr. Hernández works at the Luxembourg Institute of Health (LIH) at the Human Motion, Orthopaedics, Sports Medicine and Digital Methods under the direction of Dr. Bernd Grimm (PI). He works as a Senior Research Coordinator for the SmILE (Smart Implants in Orthopaedics) project.

Dr. Rene Peter Bremm

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CURRENT POSITION:

Senior Scientist at the Human Motion, Orthopaedics, Sports Medicine and Digital Methods (HOSD) Platform, Luxembourg Institute of Health

BIOSKETCH:

Dr. Rene Peter Bremm is an electrical engineer and a senior research professional with over a decade of experience in clinical research with smart wearable technologies. In 2015, he completed training on advanced research prototypes for neuromodulation therapy at the Neural Engineering Laboratory, Mayo Clinic, US. He earned his PhD in Engineering Sciences from the University of Luxembourg in 2019, conducting his research in the Systems Control Group led by Prof. Dr. Jorge Gonçalves at the Luxembourg Centre for Systems Biomedicine. His doctoral work focused on developing closed-loop deep brain stimulation paradigms using wearable sensors to improve therapeutic outcomes for movement disorder patients.

From 2020 to 2023, Dr. Bremm coordinated and conducted a clinical research project at the Centre Hospitalier de Luxembourg in the National Department of Neurosurgery headed by Dr. Frank Hertel. At that time, he focused on clinical gait analysis to develop diagnostic models for neurological disorders by combining smart wearables and machine learning. Rene has lectured on medical technology at Trier University of Applied Sciences in 2023.

Before joining his current institution, Dr. Bremm worked as a data steward at the Luxembourg National Data Service, where he delivered data governance and stewardship services for the public sector.

Currently, Rene Peter Bremm works as a Senior Scientist at the Luxembourg Institute of Health in the Human Motion, Orthopaedics, Sports Medicine and Digital Methods (HOSD) platform led by Dr. Bernd Grimm (PI). In this role, he is dedicated to the SmILE project and further human motion–related initiatives.