Who are we?

Sano Science is an **international research institute** based in Kraków. **We develop modern computer methods for the prevention, diagnosis, and treatment of diseases.** All this is to meet the overarching worldwide need for efficient, effective, and streamlined healthcare and to create the largest institution of this type in Central Europe!

We focus on interdisciplinarity and cooperation of all specialists in the field of broadly understood **medicine, computer science and technology.**

Sano is co-created with:

- **The University of Sheffield United Kingdom**
- **Jülich Forschungszentrum Germany**
- **Klaster LifeScience Kraków**
- **Fraunhofer ISI Germany**
- **Cyfronet AGH Krakow Poland**

This project has received funding from the European Union's Horizon 2020 research and innovation programme and from the International Research Agendas Programme of the Foundation for Polish Science.

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European Funds Smart Growth
Republic of Poland
FNP Foundation for Polish Science
European Union European Regional Development Fund

Sano Centre's core activities:

- **Excellence Science:** Researching new algorithms, models and computing technologies for personalized medicine
- **Education:** Developing innovative training programs & education that meet the needs of modern personalized medicine
- **Industrial collaboration:** Supporting enterprise development in the area of new diagnostic and therapeutic technologies
- **Commercialization:** Introducing novel diagnostic methods and therapies based on computer simulations into clinical practice

Shape the future of healthcare with us!

Find us!

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sano

Centre for Computational Personalized Medicine International Research Foundation

We create computational technologies for optimized healthcare!

www.sano.science

6 research teams in Sano Centre:

Health Informatics, VR & Robotics Lab

Medical data plays a crucial role in decision-making at all stages. We utilize our resources and methods to optimize acquisition, storage, retrieval and use of healthcare information. We focus on advancing medical communication and workflows using cutting-edge technologies such as artificial intelligence (AI), virtual and augmented reality (VR/AR), and robotics. Our research on robotic systems exploits differentiable simulations in deep reinforcement learning to enhance their autonomous capabilities. We have created state-of-the-art computer vision algorithms using deep learning techniques, closing the gap between AI and clinicians to raise trust in supportive models in treatment planning. We have also leveraged virtual environments to facilitate data and knowledge exchange among clinicians in collaborative social settings, where our surgical simulators assist in skill development and testing.

Leader: Przemysław Korzeniowski, p.korzeniowski@sanoscience.org

Computer Vision/Brain&More Lab

The main focus of this team is on cutting-edge research in neuroimaging, spanning different neuroimaging modalities including histopathology and MRI. The group has a track record of benefitting from machine learning to analyze various modalities of MRI, focusing on brain connectivity – both functional and structural (Crimi et al. Neuroimage 2021, ElSheik et al. Frontiers in Neuroscience 2021). We also focus on neurodegeneration and brain lesions (from glioma to multiple sclerosis). Recently, the group has been exploring novel technologies such as quantum computing (Wierzbinski et al., Nature SciRep 2023) and federated learning.

Leader: Alessandro Crimi, a.crimi@sanoscience.org

Extreme-scale Data and Computing

The team investigates the applicability of methods and tools of large-scale computing systems to medical applications. Main areas of research include: development of new tools supporting large-scale computing and data analysis; distributed and federated learning for medical applications; performance evaluation and optimization of medical applications on emerging computing infrastructures, including cloud and serverless computing. Besides Sano funding, the team has acquired two EU grants: (1) NearData: usage of HPC and cloud for building a transcriptomics atlas pipeline, (2) InSilicoWorld: supporting computational campaigns on large patient cohorts, with performance monitoring and secure storage. The team is involved in development of several software services, including the Model Execution Environment, CloudVVUQ library and the HPC-Whisk serverless platform.

Leader: Maciej Malawski, Director of Sano, m.malawski@sanoscience.org

Personal Health Data Science

The research goal of this team is to revolutionize healthcare by prioritizing prevention. The team is comprised of experts who develop innovative approaches using personal and secondary care data. This includes accurate algorithms to detect patterns and warning signs, and predict health risks. Using modern machine learning techniques, we unlock hidden insights in small datasets, identifying disease factors and personalized preventive strategies. In close collaboration with healthcare providers, we develop models to empower proactive risk identification. Beyond individual health, we also identify population-level trends to support informed intervention and mitigation of preventable diseases. Our work aims to transform healthcare, with focus on prevention for improved outcomes. The team has published several influential papers devoted to processing datasets and stratifying disease risks through analysis of biomarkers and machine self-semantic learning.

Leader: Jose Sousa, j.sousa@sanoscience.org

Clinical Data Science

The main objectives of this team include solving pre-clinical problems to better understand diseases and their biology, and develop computational methods that provide treatment recommendations, design computational network medicine to further investigate drugs which fail late-phase clinical trials, predicting new purposes for FDA-approved drugs, tackling clinical challenges, designing and implementing computational methods to support decision-making and assist clinicians in making informed decisions based on real-world evidence using comprehensive data, as well as investigating the potential of generative AI to push the boundaries of innovation. To-date achievements include a medicine network for drug repurposing, which has successfully contributed to the discovery of COVID-19 treatment (e.g., Pfizer's Paxlovid) and studying Alzheimer's disease. Our investigation of ChatGPT places us among the few research teams which actively contribute to this rapidly-evolving field.

Leader: Ahmed Abdeen Hamed, a.hamed@sanoscience.org

Scientific Programmers

The Scientific Programming Team assists Sano research teams in developing IT solutions required in their respective projects, ensuring that they can meet the demands of practical usage, and thus become the foundation for exploitation activities. The team consists of IT specialists, each of which is affiliated with one or multiple research teams. The work of Team has resulted in over two dozen software systems and services deployed for the benefit of Sano researchers, or to enable broad dissemination of Sano research results. Examples include the Brainspread tool which simulates the spread of chemical agents in cerebral tissue, the HPHOB hydrophobicity density calculator for protein folding simulations, the NF Organized Systems tool which models feedback loops in organic regulatory processes, multiple data registries and databases for storing and curating research data, end-user interfaces for medical professionals participating in clinical trials (e.g., for a treatment effectiveness monitoring project underway at Sano), as well as many others.

Leader: Piotr Nowakowski, p.nowakowski@sanoscience.org