ETH zürich

Annual Report 2022

Competence Centre for
Rehabilitation Engineering and Science

REHABILITATION
ENGINEERING
SCIENCE

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Content

Welcome

The global need for rehabilitation is growing, but it is still largely unmet, leaving a huge opportunity to better the lives of many people. Politicians and society are advocating for equal and self-determined societal participation for people with disabilities, while health-care services are shifting away from institutions and toward outpatient and home settings. These difficulties necessitate multimodal approaches to guiding and tracking patients and people with disabilities over time through a wide range of services.

The ETH Competence Centre for Rehabilitation Engineering and Science (RESC), as the coordinating body of the ETH Rehab Initiative, which aims to advance and promote rehabilitation as a key pillar alongside its health and medicine strategy, supports this transition and facilitates a technology-driven but holistic approach that takes into account medical, economic, environmental, legal and ethical considerations towards further developing the continuum of care. The vision is to restore and maintain independence, productivity and quality of life for patients and people living with disabilities, and to contribute towards an inclusive society.

In this report we look back on RESC's third year, which was marked by an emphasis on increasing activities in research, education and outreach. Highlights for 2022 include the creation of new core professorships and labs in data science and architecture and care, as well as additional funding programmes, new educational formats and the first RESC symposium.

Outstanding progress has been made in the field of education. RESC successfully coordinated and established a new rehabilitation and inclusion education programme for Bachelor's and Master's students in health sciences and technology. We are excited to educate future professionals who will be able to address societal challenges in the areas of rehabilitation and inclusion.

All activities are only possible thanks to the shared vision of many people, strong partnerships with the private sector and tremendous personal and financial support. We would like to thank our partners and all involved individuals, organisations and companies for their outstanding commitment.

Dr Oliver Stoller
Executive Director

Prof. Robert Riener
Chair

Prof. Roger Gassert
Vice Chair

Dr Serge Altmann
Chair of the Advisory Board

2022 at a glance

New professorship
Biomedical Data Science, Catherine Jutzeler, Schulthess Klinik, ETH Zurich

New research lab
Spinal Cord Injury and Artificial Intelligence (SCAI), Diego Paez, Swiss Paraplegic Centre, ETH Zurich

RESC roundtable at Assistive Technology Forum

RESC team retreat

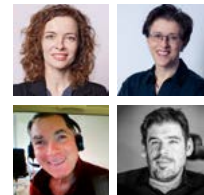**RESC Steering Committee meeting**

New partner
RESC partners with ETH Zurich spin-off Auxivo

Welcome to the RESC Advisory Board
Giovanna Battagliero, Jacqueline Martin, Nils Jent, Stefan Bützberger, Brian McGowan

**RESC pane
discussion
RehabWee**

New memb
Florian Br
Roman Go
Carsten M

January	February	March	April	May	June	Ju

Onboarding
Desiree Beck, Education Manager

New members
Gudela Grote, Zina-Mary Manjaly, Jürgen Pannek, and René Rossi

ETH Zurich and the Swiss Paraplegic Foundation are now working together in the field of personalised medicine. Their common research goal is to use new data collection techniques to help improve long-term quality of life for paraplegics.

SWISS NEUROREHAB

ETH Zurich's RESC and RELab join SwissNeuroRehab Consortium, a flagship project funded by Innosuisse.

TATKRAFT

New partner
RESC partners with Tatkraft association

reha schweiz
Schweizerische Gesellschaft für Physikalische Medizin und Rehabilitation
Société Suisse de Médecine Physique et Réadaptation
Società Svizzera di Medicina Fisica e Riabilitazione
Swiss Society of Physical Medicine and Rehabilitation

New partner
RESC partners with Swiss Society of Physical Medicine and Rehabilitation
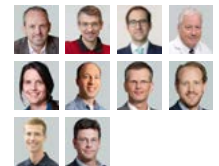
RESC Steering Committee meeting

**RESC Advisory
Board meeting**

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Research grant
awarded to
RehabCoach – a
digital platform that
supports remote
rehabilitation
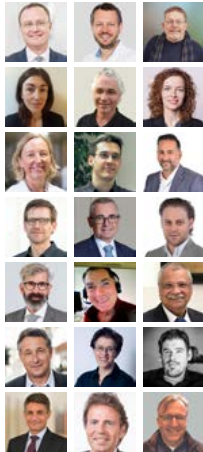

**Launch of RESC
online lecture series**

**RESC General
Assembly meeting**

New professorship
Architecture and
Care, Anna Puigjaner,
Stavros Niarchos
Foundation
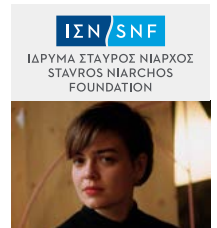
ly	August	September	October	November	December	January 2023

New partner
RESC partners with
start-up TWIICE,
makers of state-of-
the-art exoskeleton
technology

**RESC Partnership
Council**

**RESC networking
event**
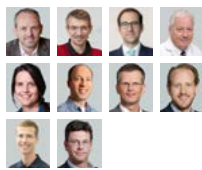
RESC symposium

**RESC Steering
Committee meeting**

**RESC evaluation
report phase 1**
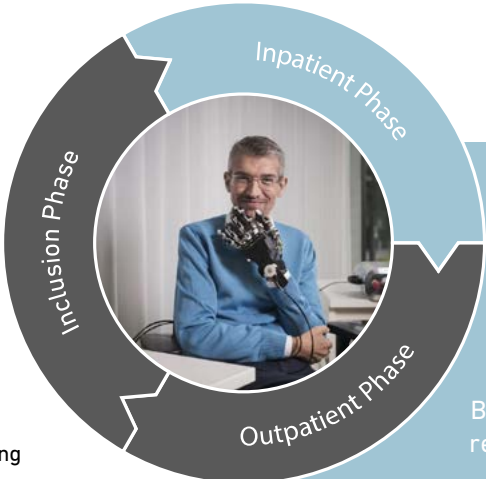
Success stories

Individuals with disabilities are at the heart of everything RESC does. The success stories highlight the potential of rehabilitation and inclusion for both individuals and society.
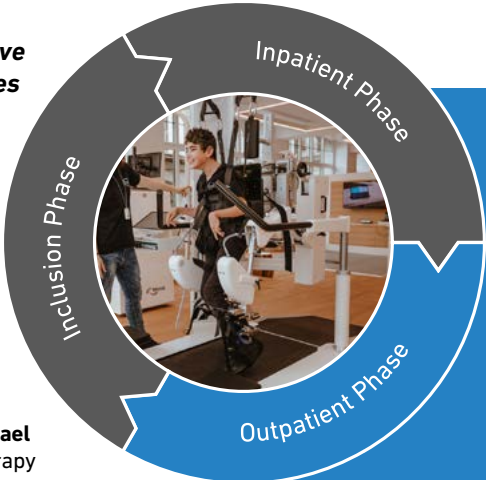
"Both people and technology played a significant role throughout my rehabilitation process"

Prof. Roger Gassert
Professor for
Rehabilitation Engineering

Inclusion Phase

Inpatient Phase

Outpatient Phase

7 months in intensive care unit

7 months in intensive inpatient rehabilitation

Back as ETH professor for rehabilitation engineering

"High-quality intensive rehabilitation services change lives."

Nilofar Niazi with Nathanael
Founder and CEO Nextherapy

Inclusion Phase

Inpatient Phase

Outpatient Phase

Son born with CP and severe motor impairments

Mother founds Nextherapy centre in Zurich

Receives continuous intensive rehabilitation and lives with his family

"Everything is possible, if there is a will combined with high-level training technologies"

Inpatient Phase

Inclusion Phase

Outpatient Phase

Heinz Frei
Paralympic Gold Medallist
and World Champion

Accident when he was 20 years old

Started to perform intensive therapy and sports
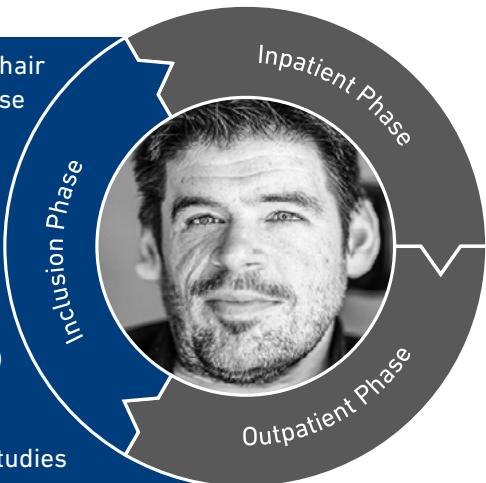
Won 35 Olympic medals and 14 World Championships

Lives in a power wheelchair due to a muscular disease

Studied history at the University of Zurich

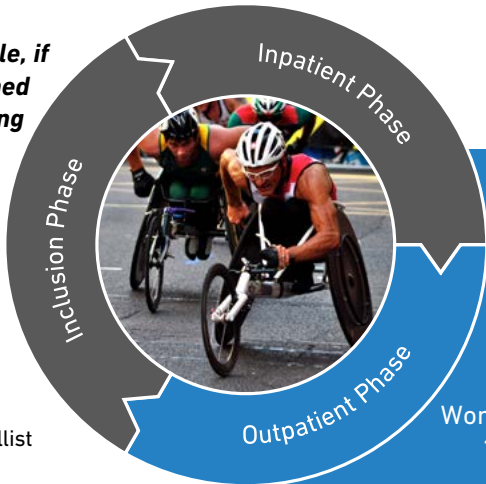Head of the first municipal office for the equality of people with disabilities (City of Bern)

Co-founder of the Swiss Network for Disability Studies

Inpatient Phase

Inclusion Phase

Outpatient Phase

"Inclusion must focus on both individual (medical impairment), and structural (obstacles in the environment) parts of a disability."

Brian McGowan
Co-president at Sensability.ch and Lecturer at various Swiss universities

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"People with disabilities should be involved in political decisions"

Inpatient Phase

Inclusion Phase

Outpatient Phase

Born with cerebral palsy

Lives with movement and speech impairments

Motivator, speaker and member of the Municipal Council

Running for Member of Swiss Parliament in

Islam Alijaj
Disability Lobbyist and
Social Entrepreneur

The Competence Centre

The Competence Centre for Rehabilitation Engineering and Science (RESC) has implemented and coordinated the ETH Rehab Initiative since its inception in 2020, drawing on expertise from academia, hospitals, industry, government, health insurance companies and disability organisations.
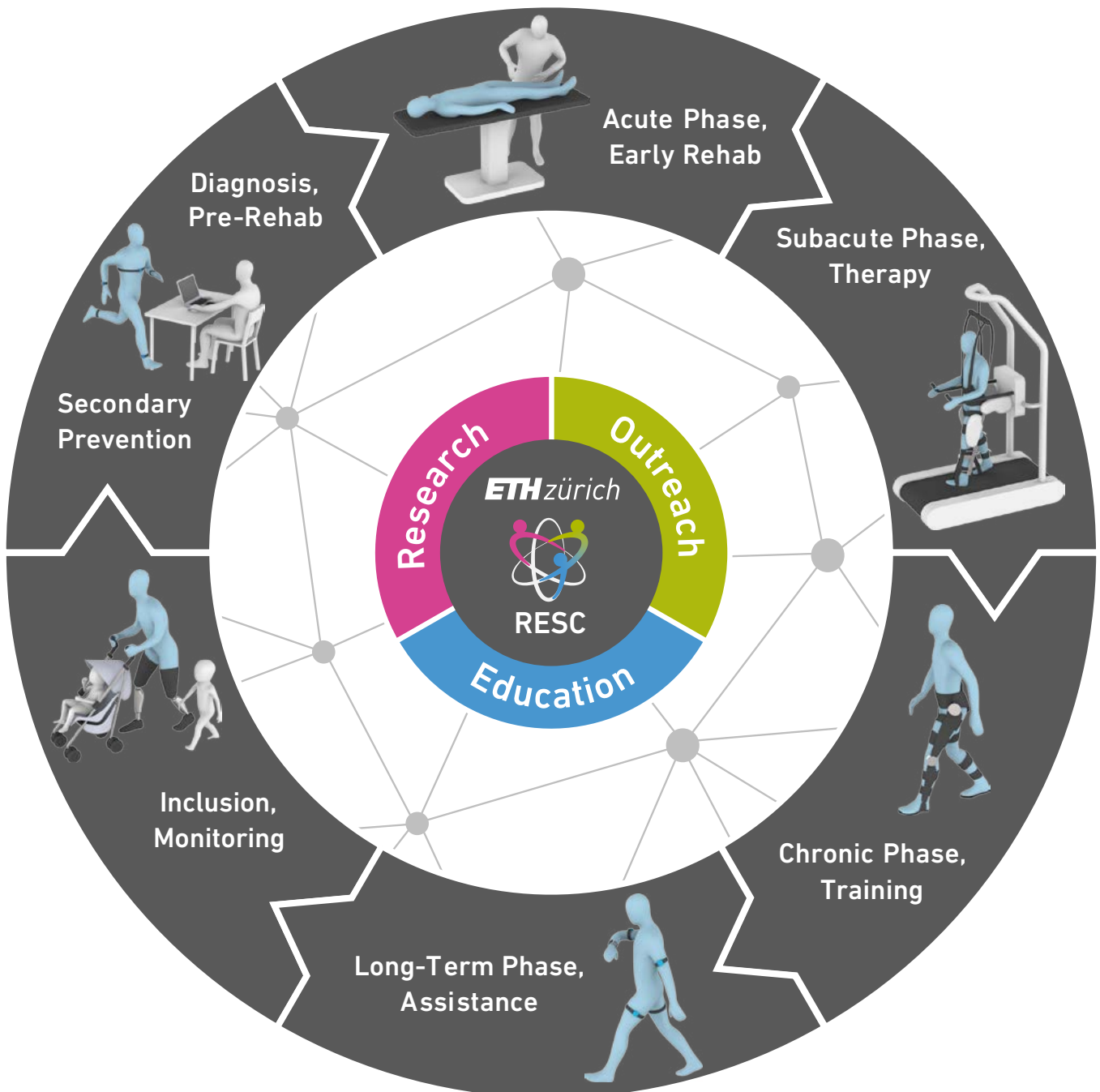
RESC seeks to directly support national and global initiatives in rehabilitation and inclusion by addressing key challenges such as expanding and decentralising service delivery (e.g. remote rehabilitation); improving the availability of technology for therapy, monitoring and independent living (e.g. assistive and sensor technology); enabling interdisciplinary settings toward the continuum of care (e.g. health economics, architecture); and providing translational research amplification. The primary goal is to support and facilitate a technology-driven but holistic approach to further develo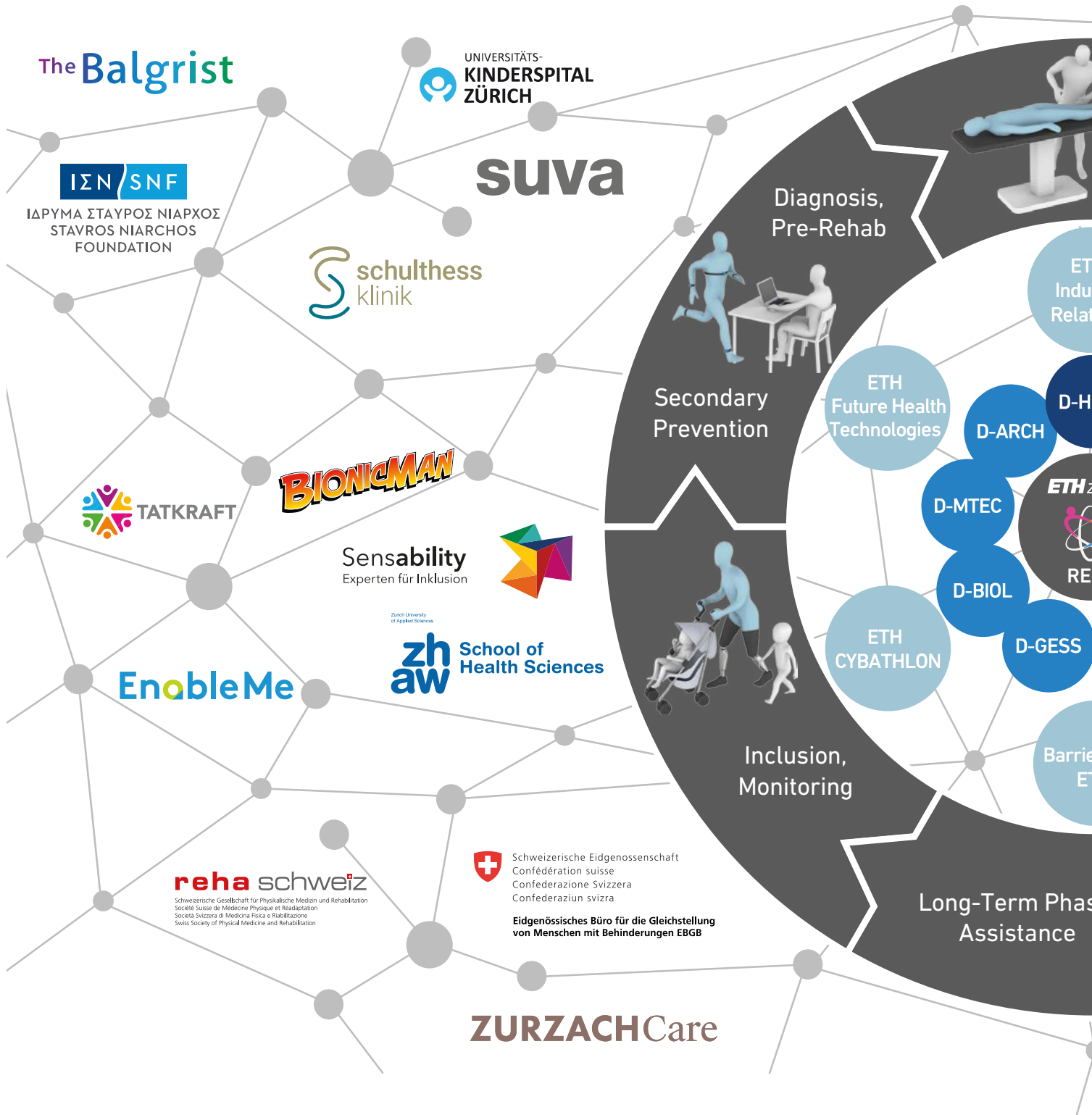ping the continuum of care, taking into account medical, economic, environmental, legal and societal factors. The main accomplishments of the centre since its inception in 2020 are listed below.

ETH RESC Main Achievements 2020 - 2022					
Network					
65 Members	**21** Advisors	**5** Strategic Partners	**10** Knowledge Partners	**7** Start-up Partners	**12** Associated Universities and Clinics

Research	**Education**	**Outreach**
Architecture & Care, SNF, 10 Mio	BSc HST Core Elective in Rehabilitation and Inclusion	Annual RESC Symposium
Data Science, Schulthess, 10 Mio		3 Roundtable Discussions
SCAI Lab, SPS/SPZ, 5 Mio	MSc HST Major in Rehabilitation and Inclusion	Campaign "Faces of Inclusion"
Suva, 1 Mio		Exhibition "Mobility & Inclusion"
National Flagship Member, 270k	RESC Lecture Series	
Uplift Fundraising Initiative, 260k		
3 Research Programmes		

RESC's mission is to promote the development of a holistic rehabilitation approach to better meet the needs of people with physical disabilities by facilitating research and transfer, fostering an interdisciplinary network and raising awareness throughout the continuum of care. The following report summarises the centre's accomplishments in 2022.

Network

The Balgrist

UNIVERSITÄTS-KINDERSPITAL ZÜRICH

ΙΣΝ/SNF
ΙΔΡΥΜΑ ΣΤΑΥΡΟΣ ΝΙΑΡΧΟΣ
STAVROS NIARCHOS
FOUNDATION

suva

schulthess klinik

Diagnosis, Pre-Rehab

ETH Future Health Technologies

ETH Indu Relat

D-H

D-ARCH

Secondary Prevention

D-MTEC

ETH RE

TATKRAFT

BIONICMAN

D-BIOL

D-GESS

Sensability
Experten für Inklusion

ETH CYBATHLON

Zurich University of Applied Sciences
zh aw **School of Health Sciences**

EnableMe

Inclusion, Monitoring

Barrie ETH

reha schweiz
Schweizerische Gesellschaft für Physikalische Medizin und Rehabilitation
Société Suisse de Médecine Physique et Réadaptation
Società Svizzera di Medicina Fisica e Riabilitazione
Swiss Society of Physical Medicine and Rehabilitation

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

**Eidgenössisches Büro für die Gleichstellung
von Menschen mit Behinderungen EBGB**

Long-Term Phas Assistance

ZURZACHCare

The current network comprises a group of leading Swiss partners to provide a platform for communication and collaboration, as well as to contribute to the strategic development of the health and medicine domains at ETH Zurich. RESC spans nine ETH departments and is home to 45 internal and 20 external research group leaders, including professors and senior scientists. The centre is advised by 21 individuals from science, industry, government and/or associations. Through the annual Partnership Council, our strategic partners (Hocoma, Stavros Niarchos Foundation, Schulthess Klinik, Swiss Paraplegic Foundation and Suva) participate in strategic alignment. The network includes several relevant universities, hospitals and rehabilitation and inclusion associations, as well as numerous relevant start-ups.

Acute Phase, Early Rehab

Subacute Phase, Therapy

Chronic Phase, Training

ETH Foundation

ETH Transfer

D-ITET

D-INFK

D-MAVT

D-MATL

EST

SC

VAMED

KLINIKEN **VALENS**

Swiss Paraplegic Foundation

cereneo
CENTER FOR NEUROLOGY & REHABILITATION

Swiss Paraplegic Centre

myoswiss

scewo

Hocoma
a **DIH** brand

VAY

TWIICE

AUXIVO
WEARABLE SUPPORT SYSTEMS

akina

leitwert.

HACKAHEALTH

Universität Zürich UZH

klinik lengg

USZ Universitäts Spital Zürich

GELBART ORTHO TEAM

New members, advisors and partners

New members

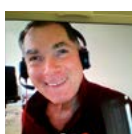|		
Dr Diego Paez	Spinal Cord Injury and Artificial Intelligence lab (SCAI), Swiss Paraplegic Centre, ETH Zurich	**ETH**zürich SCAI LAB
Prof. Catherine Jutzeler	Biomedical Data Science, Schulthess Klinik, ETH Zurich	**ETH**zürich schulthess klinik
Prof. Florian Brunner	Department of Physical Medicine and Rheumatology at Balgrist University Hospital and Medical Faculty of the University of Zurich	The **Balgrist**
Dr med. Roman Gonzenbach	Department of Neurology at the Valens Rehab Centre and Medical Co-Director of the Valens Clinics	KLINIKEN **VALENS**
Prof. Carsten Möller	Centre for Neurological Rehabilitation in Zihlschlacht and Centre for Movement Disorders and Parkinson at Klinik Hirslanden Zurich	**VAMED**
Dr Claudia Galli	Programme Director of the European Master of Science in Occupational Therapy at Zurich University of Applied Sciences (since 2012) and President of the Swiss umbrella association of the professional organizations in healthcare (SVBG)	zhaw School of Health Sciences
Dr med. Lukas Imbach	Medical Director of the Swiss Epilepsy Centre in Zurich and Lecturer at the Medical Faculty of the University of Zurich and the ETH Zurich	**klinik lengg**
Dr Bertrand Léger	Research Centre for the Suva's two rehabilitation clinics (RKB in Bellikon and CCR in Sion)	**suva**
Prof. Johannes Scherr	University Centre for Prevention and Sports Medicine at Balgrist University Hospital and Professor at the Medical Faculty of the University of Zurich	The **Balgrist**
Prof. Dominik Straumann	Interdisciplinary Centre for Vertigo & Neurological Vision Disorders and the Vestibulo-Oculomotor Laboratory at University of Zurich and Medical Faculty of the University of Zurich	**USZ** Universitäts Spital Zürich

New advisors

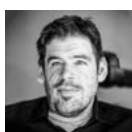|		
	Giovanna Battagliero	Director of the Rossfeld Foundation
	Dr Jacqueline Martin	CEO of the Careum School of Health at the Kalaidos University of Applied Sciences
	Prof. Nils Jent	Director of the Centre for Disability and Integration and Professor for Diversity Management at the University of St. Gallen (HSG)
	Dr med. Stefan Bützberger	President of the board of directors of the Swiss Society of Physical Medicine and Rehabilitation (SSPMR)
	Brian McGowan	Co-President and Project Manager of Sensability.ch and Diversity Officer at the Zurich University of Applied Sciences ZHAW

New partners

RehaSchweiz

Tatkraft association

Auxivo

TWIICE

Gelbart / ORTHO-TEAM

Progress through the support of strategic partners

The primary strategic goals of research are to facilitate the translation of research findings into practice and to involve stakeholders in research and development at an early stage in order to best meet their needs. RESC coordinates the establishment of professorships and labs, as well as the launch of research programmes, as part of the Rehab Initiative.

New professorship, Architecture and Care, Anna Puigjaner

Supported by the Stavros Niarchos Foundation

Prof. Anna Puigjaner has held an ETH professorship in Architecture and Care as part of the ETH Rehab Initiative since January 2023. She is a PhD architect and researcher whose work focuses on alternative domesticities, specifically alternative care architectures and practices that have the potential to reshape biased social structures.

Professor Puigjaner started her career in the Barcelona School of Architecture ETSAB – UPC, first as a student and later as an associate professor since 2005. From there, she also taught at the Valles School of Architecture ETSAV - UPC, at the Royal College of Arts, London and at the Escola Massana – Art and Design Centre, Barcelona. From 2018, she was an Associate Professor of Professional Practice at the Graduate School of Architecture, Planning and Preservation at Columbia University, New York, before joining ETH.

In response to the 2008 economic and social crisis, Prof. Puigjaner and a group of colleagues founded the Barcelona-based architectural firm MAIO, with the idea that architecture needed to respond to ongoing social changes by redefining itself. The group began working on spaces that can change over time in order to keep up with changing social and behavioural patterns, while also dismantling discriminatory settings. Their practice involves extensive research to find loopholes or openings in the existing system that allow things to change, bridging academia and professional practice.

Nowadays, as in other countries, Swiss society is aging, which has a direct impact on the population numbers with chronic health problems and disability prevalence, while rendering the current care system unsustainable. At the same time, recurrently, architecture has been designed to make some people, and some actions, invisible, undervaluing care work (especially home care work) and those who perform it. In this situation, there is a need to redefine the definition of care and rehabilitation - its related spaces, labour economies and people that carry it out. The research chair's vision is to learn how the built environment can improve preventive care, lower costs and reduce worker demand while also providing new forms of social reconciliation and symmetries.

ΙΣΝ/SNF
ΙΔΡΥΜΑ ΣΤΑΥΡΟΣ ΝΙΑΡΧΟΣ
STAVROS NIARCHOS
FOUNDATION

D ARCH

The Stavros Niarchos Foundation (SNF) is one of the world's leading private, international philanthropic organisations, making grants to nonprofit organisations in the areas of arts and culture, education, health and sports, and social welfare. SNF funds organisations and projects worldwide that aim to achieve a broad, lasting and positive impact for society at large, and exhibit strong leadership and sound management.

SNF supports the ETH Rehab Initiative by funding the professorship in the area of barrier-free, inclusive architecture, named the professorship in Architecture and Care.
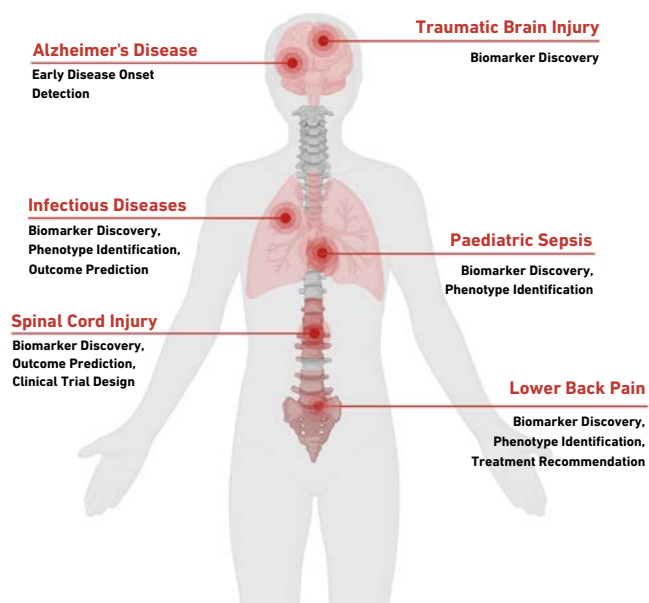
New professorship, Biomedical Data Science, Catherine Jutzeler

Supported by the Wilhelm Schulthess Foundation

Founded in January 2022, the Biomedical Data Science lab is an interdisciplinary, motivated, young research team working at the intersection of medicine, data science and biology. The group aims to identify causes, risk factors and biomarkers of disease progression. At the core of their research is a series of prospective and retrospective investigations that integrate genetic, multi-omics, biochemical, clinical assessments, imaging data and medication history with both traditional epidemiological approaches and machine-learning algorithms. Currently, the group is conducting research projects in the fields of neurology, pain and infectious diseases (e.g. sepsis in children and adults). In addition to research, the team is committed to educating and training the next generation of data scientists. To this end, the lab offers lectures, master thesis supervision and project supervision to students interested in the field of biomedical data science. The major goal is to provide students with an introduction to applied data science (programming, analysis, visualisation) to solve biomedical questions.

Research areas of the Biomedical Data Science lab in 2022

Alzheimer's Disease
Early Disease Onset Detection

Traumatic Brain Injury
Biomarker Discovery

Infectious Diseases
Biomarker Discovery, Phenotype Identification, Outcome Prediction

Paediatric Sepsis
Biomarker Discovery, Phenotype Identification

Spinal Cord Injury
Biomarker Discovery, Outcome Prediction, Clinical Trial Design

Lower Back Pain
Biomarker Discovery, Phenotype Identification, Treatment Recommendation

The mission of the Biomedical Data Science lab is to develop and implement cutting-edge data-driven solutions that improve healthcare delivery and patient outcomes. The lab's aims include advancing precision medicine, streamlining clinical workflows, improving patient engagement and reducing the overall cost of care. The Biomedical Data Science lab is also dedicated to fostering collaboration and innovation, working with healthcare providers, researchers and industry partners to develop solutions that address some of the most pressing healthcare challenges of our time.

The Wilhelm Schulthess Foundation sponsors the Schulthess Klinik for Orthopaedic Surgery, Neurology, Rheumatology and Sports Medicine. The Schulthess Klinik and the Department of Health Sciences and Technology (D-HEST) at ETH Zurich have been working together successfully for many years in the field of medical technology, particularly in biomechanics.

The Wilhelm Schulthess Foundation supports the establishment of a tenure-track assistant professorship in Biomedical Data Science.

New research lab, Spinal Cord Injury and Artificial Intelligence (SCAI), Diego Paez

Supported by the Swiss Paraplegic Foundation

The Spinal Cord Injury and Artificial Intelligence lab (SCAI) aims to improve the long-term prognosis of Spinal Cord Injury (SCI) by continuous monitoring and data-based modelling of body functions. The group investigates artificial intelligence methods to construct a more holistic understanding of disease development and interactions between multiple secondary conditions in SCI. The first year's work focused on researching morbidities in SCI and wearable sensing technology for improving health care in outpatient life. We focused on identifying digital biomarkers towards enhancing clinical decision-making and enabling new interventional strategies. The lab aims to deliver personalised predictive systems in medicine and rehabilitation, which we will translate into digital twin models that combine clinical and remote sensing technology.

settings and researching its potential implementation in projects related to cardiovascular function monitoring in SCI. This is to be conducted in collaboration with the Laboratory for Movement Biomechanics led by Prof. Bill Taylor. In the coming year, the focus will be on expanding the group through new external funding and collaboration with Swiss and international partners on long-term monitoring and digital twin modelling work that could be extended from SCI to other patient populations.

The SCAI lab joined the Swiss Paraplegic Research Institute (SPF) as a new group in digital health care and rehabilitation during its first year, aligning the research agenda with the entire institute and expanding its reach for future implementation. The Swiss Paraplegic Centre (SPZ), ETH Zurich and other international partners have established strong collaborations with the lab. New projects for long-term implementation in outpatient health monitoring are being developed, and the group is growing through external funding and collaborations.

One project aims to transfer the design of a bioimpedance-based sensor for remote bladder volume measurement, a promising method that will be assessed for feasibility among the SCI population in collaboration with the project-based learning centre (PBL) led by Dr Michele Magno.

A second project, which started in March 2023 after successfully acquiring funding from RESC-SPS, will focus on developing a new sensor for monitoring wheeling activity as a means of quantifying the physical activity of manual wheelchair users in community

The Swiss Paraplegic Foundation (SPS) in Nottwil (Canton Lucerne) is one of the largest solidarity networks in Switzerland. It is the umbrella organisation of the Swiss Paraplegic Group (SPG), which comprises an integral network of services for the comprehensive rehabilitation of people with a spinal cord injury. The combination of complete services from the scene of the accident through to medical care and rehabilitation, as well as lifelong support and advice, is unique. The membership fees of the 1.9 million people who belong to the Benefactors' Association of the SPS provide the funding for this solidarity network's activities. Every day, around 2000 employees are committed to fulfilling their challenging tasks. The SPS was founded by Dr Guido A. Zäch in 1975.

The SPS supports the establishment and operation of the SCAI lab and further research through an ETH RESC funding programme in the field of personalised health for individuals with spinal cord injury.

Research funding programmes, Swiss Paraplegic Foundation, Suva

Supported by the Swiss Paraplegic Foundation and the Suva

In 2022, RESC established two new research funding programmes. With the support of Suva, RESC launched the second funding programme in the areas of prevention, rehabilitation, assistance, inclusion and health economics with a focus on accident-related injury in February 2022. And a few months later, the third funding programme with the support of the Swiss Paraplegic Foundation (SPS) was launched to support research and development that address challenges and opportunities in personalised health for individuals with spinal cord injury.

RESC research grants are intended to promote interdisciplinary and translational research and development projects that will pave the way for future rehabilitation, such as the holistic management of impairments across the continuum of care. The overall goal is to develop novel treatment and assistance solutions to improve accessibility and quality in rehabilitation medicine, as well as to make our environment more inclusive in general.

ETH RESC Research Funding Programmes 2022

ETH RESC – SPS Funding Programme

First Call:
Monitoring Technologies for Clinical Decision Making in Spinal Cord Injury

Selected Projects:
pAIn-sense - An Artificial Intelligence Based Telemonitoring Tool to Measure Pain in Spinal Cord Injury Patients in at-home Settings (192 kCHF)

FMW - A Lightweight Force Measurement Wheel System for Assessing Wheelchair Activity in Daily Life (276 kCHF)

ETH RESC – Suva Funding Programme

First Call:
Remote Rehabilitation

Selected Project:
RehabCoach - A Digital Platform that Supports Remote Rehabilitation (300 kCHF)

The Swiss national accident insurance fund, Suva, is an important part of the Swiss social security system and Switzerland's largest accident insurance provider. As an independent company under public law, Suva insures people at work and in their personal lives. The Suva model combines prevention, insurance and rehabilitation. It enables people who have had an accident or become ill to receive optimal care and helps them get back to work as quickly as possible. In addition to its insurance branch, Suva runs two rehabilitation clinics as an additional business.

Suva supports an ETH RESC research funding programme in the areas of prevention, rehabilitation, assistance, inclusion, and health economics with a focus on accident-related injury.

suva

Research

The primary strategic goals of research are to facilitate the translation of research findings into practice and to involve stakeholders in research and development at an early stage in order to best meet their needs. RESC coordinates the establishment of professorships and labs, as well as the launch of research programmes, as part of the Rehab Initiative.

New research chairs, labs and programmes

In 2022, RESC worked closely with the ETH Foundation and the ETH Office for Faculty Affairs to fund and establish a further research chair in health economics (Economic Evaluation of Health Programmes and Technologies and Disability and Inclusion in Society). Furthermore, RESC laid the foundation to establish a fellowship programme on rehabilitation and inclusion.

RESC actively promotes cross-disciplinary collaborations in research, development, and transfer, and supports collaborative research through competitive grants funded by our partners and other sources. The goal is to fill existing research gaps and connect research topics with existing competencies at ETH Zurich and external stakeholders in order to overcome current rehabilitation and inclusion challenges. The first RESC-supported project, "Hackster," which is being funded by the Uplift Fundrai-

sing Campaign, is progressing well and has presented preliminary results (see status on page 20). The ETH RESC - Suva Funding Programme's 2022 funded project "RehabCoach - a digital platform to support remote rehabilitation" is also on the way. The project will create a first proof-of-concept for remote technology-supported interventions that can be applied to other rehabilitation applications. The project will begin in October 2022, under the direction of RESC members Dr Olivier Lambercy (ETH) and Prof. Tobias Kowatsch (UZH) (see status on page 21).

Professorships	Biomedical and Mobile Health Technology **ETH** zürich	Healthy Ageing **ETH** zürich	Data Science for Personalised Health schulthess klinik	Architecture and Care ΙΣΝ/SNF ΙΔΡΥΜΑ ΣΤΑΥΡΟΣ ΝΙΑΡΧΟΣ STAVROS NIARCHOS FOUNDATION
	Economic Evaluation of Health Programmes and Medical Care Fundraising	Disability and Inclusion in Society Planning	Human Wound Healing and Antifibrotic Therapies On hold	Personalised Health Care for Spinal Cord Injury Swiss Paraplegic Foundation Planning
Labs and Programmes	Personalised Health Care for Spinal Cord Injury SCAI Lab Swiss Paraplegic Foundation	Research programme on prevention, rehab, assistance and inclusion **suva**	Fellowship programme Fundraising	Research programme on rehabilitation and inclusion Fundraising

National research activities

RESC began to facilitate the formation of consortia and larger research and development projects involving a wide range of stakeholders. RESC is a member of the national Innosuisse Flagship Project "SwissNeuroRehab" 2022-2027 in this context. The project's goal is to create and validate an effective and efficient neurorehabilitation model using new digital and technological methods across the continuum of care, from hospital to home. SwissNeuroRehab brings together an unprecedented group of Switzerland's leading companies and institutions. The project's first phase will concentrate on stroke, traumatic brain injury and spinal cord injury.

SWISS ✚ NEUROREHAB
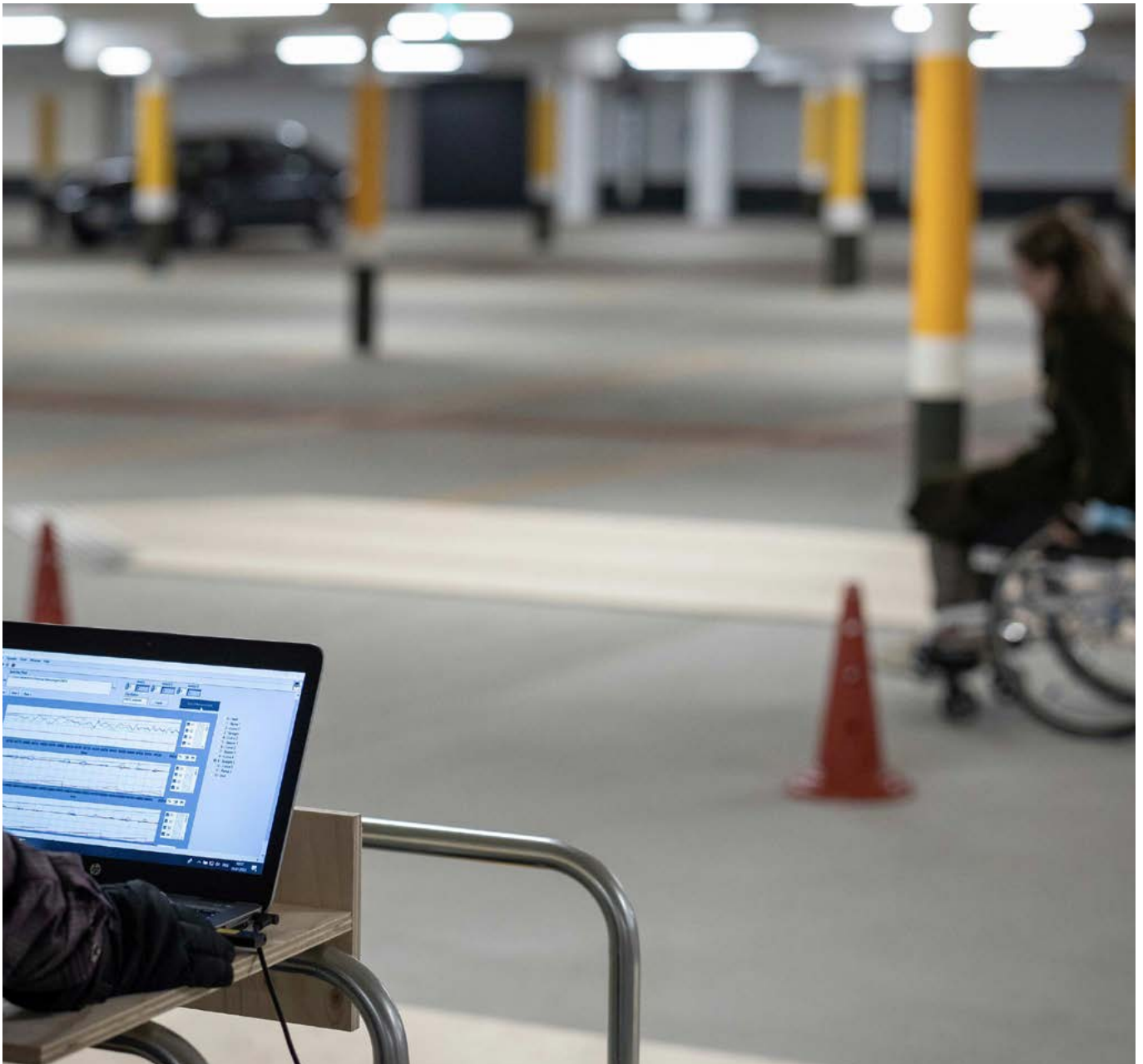
Status of project "Hackster - Patient-led innovation in online communities and physical spaces"

Funded by the Uplift Fundraising Campaign

The RESC-funded project focuses on improving the scholarly understanding of how innovation in rehabilitation and assistive technology unfolds in online communities and physical spaces, and investigates the roles of patients (users) in driving this innovation process.

Innovation through online communities with Hackster
The difficulty of effectively conveying tacit and contextual knowledge about patients and their environments to potential problem-solvers is an important finding from existing online hardware communities (e.g. Hackaday) in the process of patient-led innovation. The "Hackster" research team has devised an online experiment to investigate potential solutions to this problem. Problems in the research project "Hackster" were identified after extensive discussions with the existing online hardware community and disabled individuals willing to participate in the study.

Participants in the study will be randomly assigned to different discord channels based on their medical conditions (treatment or control). Problem-solvers in the treatment condition will receive more tacit information through videos, pictures, and other media that patients have prepared to convey tacit knowledge. Explicit content, such as formal, written descriptions of the problems that disabled people face, will be provided in the other group. Problem-solvers will be able to interact with patients in their discord channels in both cases and receive equal amounts of rewards. In comparison to the other group, the treatment group is expected to receive tacit knowledge more effectively and develop superior solutions.

In keeping with the research group's goal of being inclusive and disseminating innovation, a special emphasis will be placed on patients and problem solvers from developing countries where patients lack access to high-quality healthcare and thus require low-cost solutions. Participants in the competition will be infor-med that one of the evaluation criteria for solutions in awarding rewards is cost efficiency.

Hackathons with Hackahealth
The research team has examined half of the rich data gathered from the hackathon "Hackahealth," which included 142 hours of observation, Slack conversation records, project reports, and 103 interviews with hackers, challenges and mentors. Currently, the data has yielded two major insights. To begin, it was discovered that it was critical to reduce knowledge gaps between patients and problem-solvers in the hackathon through iterative, frequent interactions. Second, it was discovered that successful teams in hackathons that generated useful, functional solutions for patients involved networks of related stakeholders prior to, during and after the hackathons. Hackathons are critical for patients and problem solvers to connect with external stakeholders and turn their ideas into functional and usable products. However, because individual patients or problem-solvers have limited resources, the research team discovered that problem-solvers must also involve a diverse set of stakeholders and partnerships in order for the ideas to succeed. Universities, government institutions and private firms can improve on solutions developed during short hackathons, which is important because developing functional, catered hardware solutions for patients in a weekend is difficult.

Research output
A first paper has been accepted for publication in Nature Reviews Bioengineering, summarising the findings from the hackathons. Preliminary results of the Hackster competition and hackathons will also be presented at the upcoming conference by the European Group of Organization Studies in 2023. The conference will serve as an initial opportunity to receive feedback and facilitate the progress toward submitting the papers to high-level management journals.

# Status of project "RehabCoach - a digital platform to support remote rehabilitation"

Funded by the ETH RESC – Suva Funding Programme

The RehabCoach project, funded by the RESC - Suva Funding Programme, is developing a novel digital platform in the form of a smartphone app to support remote rehabilitation in an unsupervised manner. The app serves as an interface for patients to train with various rehabilitation tools without the direct supervision of a therapist, ideally in their own home. RehabCoach is based on the MobileCoach (www.mobile-coach.eu) mobile coaching app framework, an opensource software platform for behavioural health interventions and ecological momentary assessments that has previously been validated in other populations and applications. RehabCoach's vision is to create an interactive intermediate layer between patients and healthcare practitioners, increasing patients' adherence and motivation to engage in unsupervised rehabilitation, with the ultimate goal of increasing the number of patients who receive unsupervised rehabilitation, with the ultimate objective of increasing the dose of quality therapy patients can receive along the continuum of care.

The project team recently completed a first prototype of the RehabCoach app, which includes various features to support unsupervised rehabilitation. For example, chatting with a virtu-

al coach, scheduling and receiving reminders for daily therapy sessions, accessing informative videos about stroke and health, and receiving feedback on daily goals and performance are all included. In a pilot study conducted in collaboration with the Clinica Hildebrand in Brissago, four stroke survivors and five healthcare practitioners interacted with the coaching app in a single session to assess its feasibility and usability and gather feedback on additional features to consider.

The preliminary results show that it was feasible for people after a stroke to successfully operate the app after receiving minimal instructions. The interaction with the app was perceived as very positive (by both user groups) and participants rated the usability of the app as being very high. These good usability scores were confirmed by semi-structured interviews, where subjects stated for example that "The app is clean, simple", "I like the virtual coach, it humanises the app", and "[the app is] Really easy to use and to interact with". The RehabCoach project team is currently working on a first scientific publication based on this pilot study (Devittori et al. 2023, in preparation).
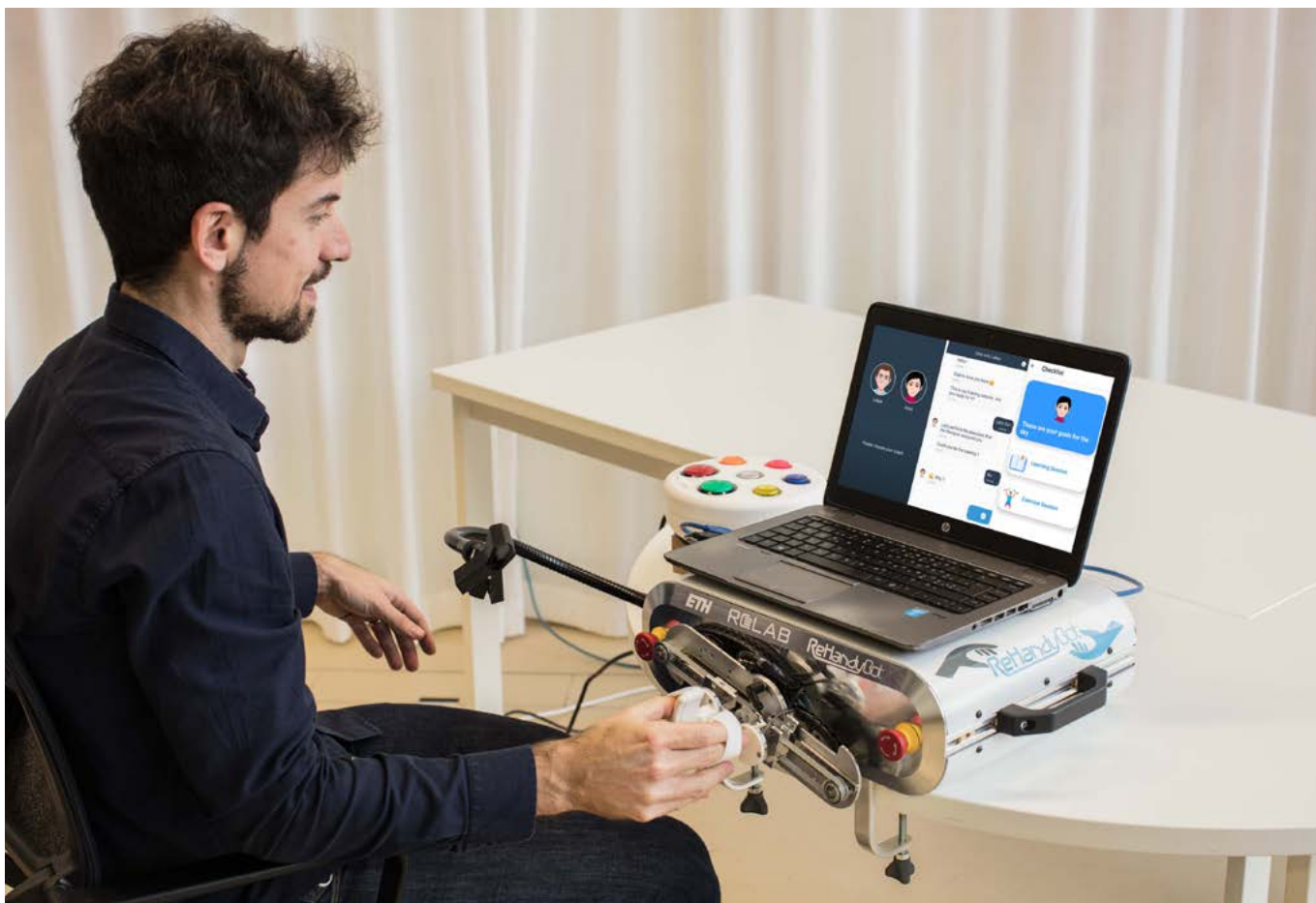
Education

RESC aims to establish a broad, cross-departmental and cross-institutional educational landscape to train the next generation of rehabilitation professionals through university and continuing education programmes as one of its key pillars. As a result, RESC uses its internal and external networks to develop highly holistic education.

Bachelor's degree level

In the Autumn Semester 2022, RESC implemented a new core elective in Rehabilitation and Inclusion within the existing Bachelor's programme in Health Sciences and Technology (HST) at ETH Zurich. The course provides insights into relevant topics along the continuum of care (e.g. rehabilitation medicine, therapy technologies, remote therapy, assistive technologies, device certification, inclusion and cost models) and prepares the students for the new Major in Rehabilitation and Inclusion within the consecutive Master's programme in HST.

Master's degree level

The new Major in Rehabilitation and Inclusion was approved by the Department of Health Sciences and Technology (D-HEST) conference and will begin in the Autumn Semester 2023. Semester courses will be available in the three focus areas of rehabilitation technology, rehabilitation medicine and inclusion. Students will place a primary emphasis on one focus area while also selecting courses from the other two focus areas to facilitate a holistic view of rehabilitation. Furthermore, practical training will be provided in RESC partner institutions to bring students into close contact with patients and people with disabilities.

ETH MSc HST - Major in Rehabilitation and Inclusion

Structure	Lectures
Practical Training 12 weeks 15 CP	**Rehabilitation Technology** • Rehabilitation Engineering • Big Data and Artificial Intelligence • Digital & Mobile Health • Technology Acceptance & Usability • Medical Technology Innovation
Lectures 30 CP **Focus Areas**	**Rehabilitation Medicine** • Neural Control of Movement • Clinical Biomechanics • Rehabilitation Medicine • Different Types of Rehabilitation • Precision Rehabilitation
Research Internship 12 weeks 15 CP	**Inclusion** • Barrier-Free Architecture • Disability Studies • Ethics in Rehabilitation & Inclusion • Disability Policy & Law • Health Economics
Master's Thesis 6 months 30 CP	

Online lecture series

As RESC seeks to rethink and reshape the entire rehabilitation environment in order to contribute to a more inclusive society for patients and people with disabilities, public awareness must be raised. In November 2022, the online and public lecture series RESC Lunch Bites was launched for this purpose. To promote RESC's vision beyond the network, top-level speakers from the RESC network and beyond will elaborate on relevant topics along the continuum of care through keynotes, active discussion rounds, and personal and research reports.

RESC LUNCH BITES
Online Lecture Series on Rehabilitation and Inclusion

Speakers from the RESC network give insights into key topics along the rehabilitation continuum of care, research and personal experiences.

Outreach

RESC's outreach activities aim to raise awareness about its work among the general public, opinion leaders in government and industry, and other relevant stakeholders. RESC seeks to participate actively in public discussions about the opportunities and challenges of rehabilitation. It contributes to finding solutions for a more inclusive society by constantly expanding its network and creating collaborative platforms. RESC is dedicated to increasing the visibility and impact of its network's members' and partners' research, potential and expertise.

Annual RESC symposium

RESC launched its first symposium "Shaping the Future of Rehabilitation" in 2022, which will be continued as an annual event. With 230 registered participants and ten national and international speakers, the programme offered insights into current topics in rehabilitation technology, rehabilitation medicine and inclusion.

Roundtable discussions

In 2022, RESC continued its panel discussions with the goal to gain a deeper understanding of challenges and potential solutions to advance the field. The second and third roundtable brought together experts in financial modelling for assistive technologies and were hosted at the Assistive Technology Forum in Nottwil (CH) and at the RehabWeek in Rotterdam (NL). The latter is the largest conference on rehabilitation technology globally.

Outlook

Towards a strong network and flagship projects

RESC will continue building and hosting a strong network and establishing partnerships, professorships and research labs, research and education programmes, and outreach activities. The centre can be seen as a central node in the Swiss rehabilitation landscape with high potential to become a national flagship in rehabilitation and inclusion research. A core activity will be greater expansion of the internal and external network to further establish the continuum of care and to directly support and complement other ETH initiatives in health and medicine. In close collaboration with the ETH Foundation, RESC will continue to acquire donators and sponsors for the ETH Rehab Initiative to fund research, education and outreach activities.

With its strong foundation, RESC will focus on and invest in a few flagship projects to support and guide national and international societal development strategies. For example, RESC plans to create an ETH Index (benchmarking) in rehabilitation and inclusion to increase public awareness, foster ongoing development processes, increase organisational engagement in implementing improvement measures, and enable comparison and competition.

Research and education portfolio

Another core focus will be the launch and implementation of research calls with already and newly established funding sources. RESC will expand its research portfolio from rehabilitation medicine and technology towards economics and social sciences, to strengthen interdisciplinary research collaboration along the continuum of care. Furthermore, RESC will strengthen its portfolio of coordinating larger national research projects in the field, e.g. "SwissNeuroRehab" or future NCCR calls.

Following the establishment of university education programmes, RESC will evaluate and address educational needs within various rehabilitation professions in order to address these in continuing education programmes. The goal is to establish a strong interprofessional and cross-institutional educational landscape in rehabilitation and inclusion that will serve as a model for others. RESC is developing a CAS in rehabilitation medicine within the existing MAS in digital Clinical Research (diCR) at ETH Zurich, based on the development of the Major in Rehabilitation and Inclusion within the existing Master's programme in HST. The CAS has already been incorporated into the MAS in diCR's business plan, and it will focus on digital clinical research in the rehabilitation setting to address medical and societal challenges. Furthermore, RESC has begun to form collaborations with external universities in order to better understand the need and market for larger continuing education programmes in the field.

Outreach portfolio

To showcase recent developments and achievements in rehabilitation and inclusion and raise awareness and motivation for investors, RESC plans to promote the exhibition on "Mobility and Inclusion" as its core outreach project at the beginning of 2024. The exhibition will serve as a basis for future events and various excurses. RESC will continue to facilitate knowledge transfer by organising several events such as conferences, networking events and media appearances.

Campaign - Faces of Inclusion

At the core of everything RESC does are the individuals living with disabilities. With the campaign "Faces of Inclusion", a portrait series, we open a dialogue with people who are affected and learn about the challenges they face due to their disabilities, and their vision of an inclusive society.

"You are always only as disabled as you feel, and so you are perceived and treated by your environment."

Rüdiger Böhm

"My greatest wish is that we can treat each other as equals and move forward together."
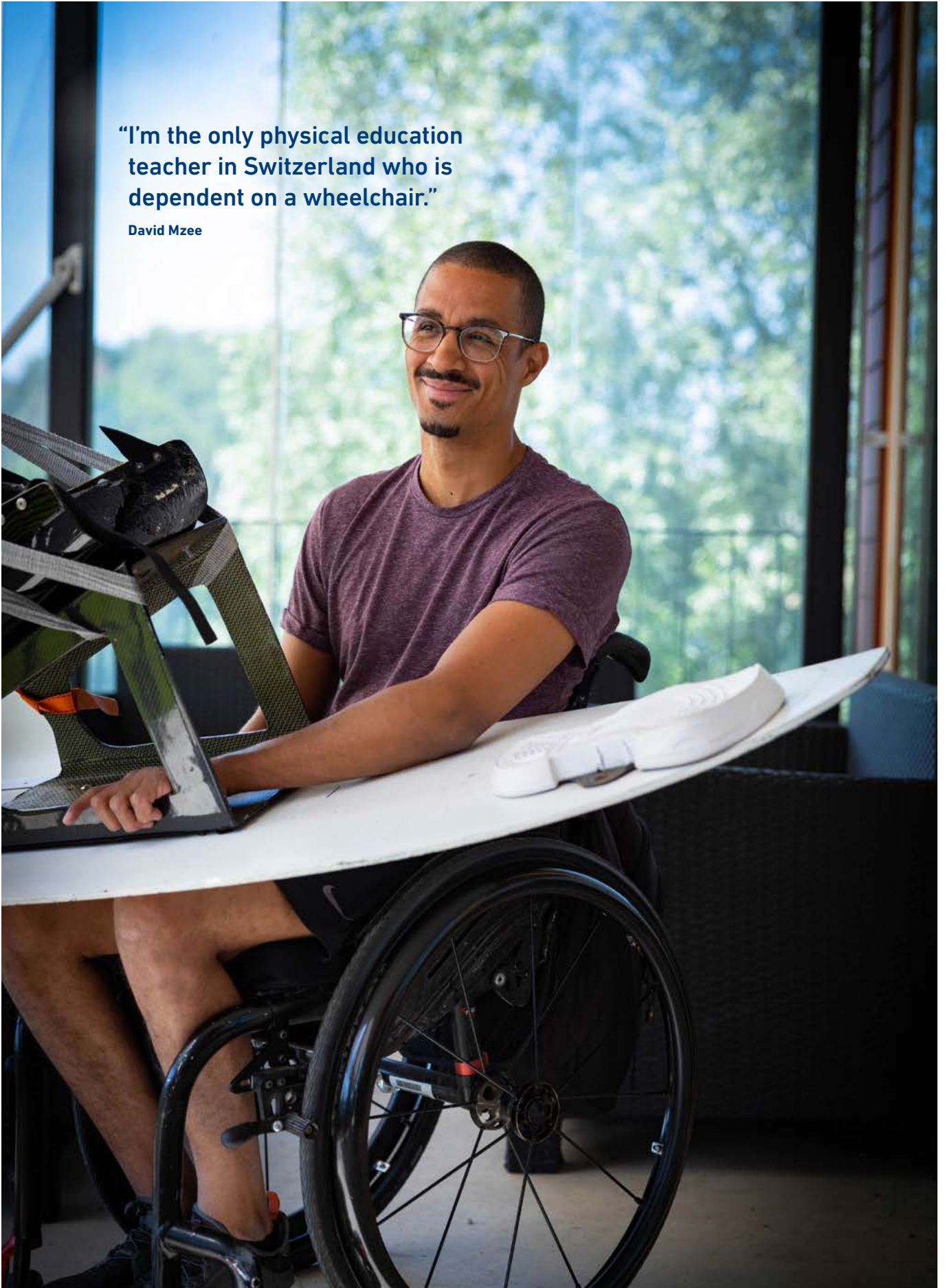
Romy Tschopp

"It's not only people in wheelchairs who depend on accessibility, but also parents with prams, older people and anyone with restricted mobility after an accident. Accessibility concerns everyone."

Linda Halter

"I'm the only physical education teacher in Switzerland who is dependent on a wheelchair."

David Mzee

"My greatest wish for the future is to live in a society in which there are no longer any marginalised groups or insurmountable barriers."

Andrea von Büren

"Disability should no longer be seen as a defect, but as a state of living."

Jahn Graf

Annex

Official bodies
Members of the General Assembly

Ordinary members (ETH internal)

Luca Benini	D-ITET	Biomedical Applications, Brain-Computer Interfaces, Machine Learning Accelerators
Katrien De Bock	D-HEST	Muscle Regeneration, Exercise, Metabolism
Eling D. de Bruin	D-HEST	Motor Control and Learning, Functional Anatomy, Virtual Reality-Driven Rehabilitation
Benjamin Dillenburger	D-ARCH	Housing Typologies, Computational Design, Digital Fabrication
Stephen Ferguson	D-HEST	Musculoskeletal Biomechanics, Regenerative Medicine, Medical Technology
Roger Gassert	D-HEST	Rehabilitation Robotics, Assistive Technology, Neural Control of Movement
Marie Glaser	D-ARCH	Social Sciences, Housing Studies, Sustainable Urban Development
Gudela Grote	D-MTEC	Leadership and Coordination in Healthcare Teams, Impact of Technology on Work in Healthcare
Isabel Günther	D-GESS	Social Impact Assessments of Technologies, Poverty and Inequality Analysis
Michael Hampe	D-GESS	Philosophy of the "Good Life", Critical Theory of Anthropological Essentialisms, Criticism of the "Nature-Culture-Divide"
Otmar Hilliges	D-INFK	Human-Computer Interaction, Computer Vision, Robotics
Christian Holz	D-INFK	Sensing Technologies Interface with End Users, Continuous Physiological Monitoring for Predictive Healthcare, Physical Computing and Computational Interaction
Marco Hutter	D-MAVT	Robotics, Control, Machine Learning
Marcello Ienca	D-HEST	Bioethics/Neuroethics and Health Policy, Disability Studies, Health Technology in Society
Taekwang Jang	D-ITET	Brain-Machine Interface, Implantable Sensors, Ultra-Low-Power Systems
Catherine Jutzeler	D-HEST	Biomedical Data Science, Data Mining, Translational Medicine
Marko Köthenbürger	D-MTEC	Public Economics of Digitization and AI, Health Expenditure Forecast, Innovation and Public Policy
Tobias Kowatsch	D-MTEC	Blended Digital Coaching with Conversational Agents (Chatbots), Just-In-Time Adaptive Interventions, Digital Biomarker Research
Olivier Lambercy	D-HEST	Rehabilitation Robotics, Technology-Based Assessments in Neurorehabilitation, Digital Biomarkers
Michael Leunig	D-HEST/ Schulthess Clinic	LIS Orthopaedics, Surgery, Outcome Research

Jörg Löffler	D-MATL	Materials Science, Biodegradable Implants, Metallic Biomaterials
Zina-Mary Manjaly	D-HEST	Neurology and Neurophysiology, Functional neuroimaging with a focus on chronic neurological disorders, Mindfulness-based cognitive interventions for improving therapeutic and rehabilitative outcomes
Isabelle Mansuy	D-HEST	Neuroepigenetics, Psychiatry, Animal Models
Mirko Meboldt	D-MAVT	Usability, Human-Machine Interaction, Engineering Design
Carlo Menon	D-HEST	Innovation in Wearable Technologies, Sensorimotor Recovery, Neurorehabilitation
Ralph Müller	D-HEST	Bioimaging, Biomechanics, Mechanobiology
Diego Paez	D-HEST	User-in-the-loop Computational Modelling and Design, Continuous Sensing and System Integration, Applied ML in Assistive Robotics
Anna Puigjaner	D-ARCH	Care, Gender and Non-normative Studies, Housing
Stanisa Raspopovic	D-HEST	Engineering, Technology Transfer, Medical Devices
Robert Riener	D-HEST	Rehabilitation Robotics, Human-Machine Interaction, Biomechanics
René Rossi	D-HEST	Smart Textiles, Wearables, Materials-Skin Interactions
Roland Sigrist	ETH CYBATHLON	Project Development and Management, Events and Communication, Human Movement Science
Jess Snedeker	D-HEST	Biomechanics, Engineering, Regenerative Medicine
Christina Spengler	D-HEST	Human Physiology in Sleep, Rest and Exercise; Medical and Health Technology
Christoph Stadtfeld	D-GESS	Social Networks, Statistical Modelling, Social Integration and Mental Health
Bill Taylor	D-HEST	Musculoskeletal Biomechanics, Medical Technology, Neuromotor Control
Philip Ursprung	D-ARCH	Contemporary Architecture; Contemporary Art; Relation of Visual Culture and Science, Economy and Politics
Effy Vayena	D-HEST	Bioethics, Data Ethics and Governance, Health Policy
Julia Vogt	D-INFK	Medical Data Science, Machine Learning, Data Mining
Georg von Krogh	D-MTEC	Strategic Management of Digital Technology and Artificial Intelligence, Innovation in Pharma and Health Care, Organisation of User Innovation
Nicole Wenderoth	D-HEST	Neurofeedback, Brain Stimulation, Motor Neuroscience
Peter Wolf	D-HEST	Human-Robot Interaction, Biomechanics, Motor Learning
Mehmet Fatih Yanik	D-ITET	Brain Machine Interfaces, Systems Neuroscience, Ultrasound Drug Delivery
Marcy Zenobi-Wong	D-HEST	Biomaterials, Bioprinting, Cell-Material Interactions

Associate members (ETH external)

Christian Baumann	UZH/USZ	Sleep, Parkinson, Innovation
Florian Brunner	UZH/Balgrist	Complex Regional Pain Syndrome, Spine Conditions, Manual Medicine
Armin Curt	UZH/Balgrist	Spinal Cord Injury, Neurophysiology, Neurology
Mazda Farshad	UZH/Balgrist	Orthopaedic Surgery, Spine, Surgical Innovation
Claudia Galli	ZHAW	Occupational Therapy, Management and Accreditation, Interprofessional Leadership
Roman Gonzenbach	Kliniken Valens	Neurorehabilitation, Neurology, Neuroplasticity
Lukas Imbach	UZH/Klinik Lengg	Brain Stimulation, Epilepsy and Disability, Sensor Technology for Diagnosis and Monitoring
Thomas Kessler	UZH/Balgrist	Neuro-Urology, Neurosciences, Clinical and Translational Medicine
Bertrand Léger	Suva/ Suva-Kliniken	Molecular Biology, Epigenetic, Clinical Research
Andreas Luft	UZH/USZ	Stroke Rehabilitation, Neural Plasticity and Learning and Reward, Telerehabilitation
Andreas Meyer-Heim	UZH/KISPI	Paediatric Rehabilitation, Spastic-Dystonia Management and Neurocognitive Function after ABI, Translational Research
Carsten Möller	VAMED	Parkinson`s Disease and other Movement Disorders, Neurorehabilitation, Clinical Neurology
Rahel Naef	UZH/USZ	Family Health, Nursing Interventions, Implementation Science
Jürgen Pannek	UNIBE/SPZ	Neuro-Urology, Incontinence, Spinal Cord Injury
Peter Sandor	UZH/ZURZACH Care AG	Neurorehabilitation, Headache & Pain, Therapeutic Interventions
Johannes Scherr	UZH/Balgrist	Exercise on Musculoskeletal and Cardiopulmonary System, Prehabilitation, Performance Assessment
Dominik Straumann	UZH/USZ	Neuro-Otology, Movement Perception, Concussion
Markus Wirz	ZHAW	Rehabilitation of Functions, Assessment of Functions, Pragmatic Research
Björn Zörner	UZH/Balgrist	Clinical Neurorehabilitation, Neuroscience, Gait Disturbances and Analysis

Honorary members (ETH internal/external)

Volker Dietz	UZH/Balgrist	Human Motor Control; Movement Disorders; Neurorehabilitation
Martin Schwab	ETH/D-HEST	Neuroscience; Drug Development; Clinical Trial Planning

Members of the Steering Committee

Robert Riener
Chair
D-HEST

Roger Gassert
Vice-Chair
D-HEST

Olivier Lambercy
Vice-Chair
D-HEST

Armin Curt
UZH/Balgrist

Isabel Günther
D-GESS

Christian Holz
D-INFK

Philip Ursprung
D-ARCH

Marko Köthenbürger
D-MTEC

Mirko Meboldt
D-MAVT

Roland Sigrist
ETH CYBATHLON

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Gery Colombo
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Centre for Accessible
Architecture

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Accessibility in Public
Spaces

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Andreas Gerber-Grote
ZHAW School of Health
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(HSG)

Chapal Khasnabis
WHO

Stefan Launer
Sonova

Brian McGowan
Sensability

Jacqueline Martin
Careum

Fabrizio Petrillo
AXA Switzerland

Andreas Roos
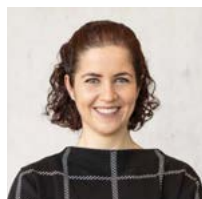VAMED Switzerland

Werner Witschi
Althaus Company

Executive Office

Oliver Stoller
Executive Director
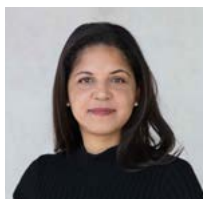
Miriam Daepp
Communications & PR

Desiree Beck
Education Manager

Stefan Schneller
Content & Multimedia

Supporting staff

Maya Ida Kamber
Administration

Diana Siedler
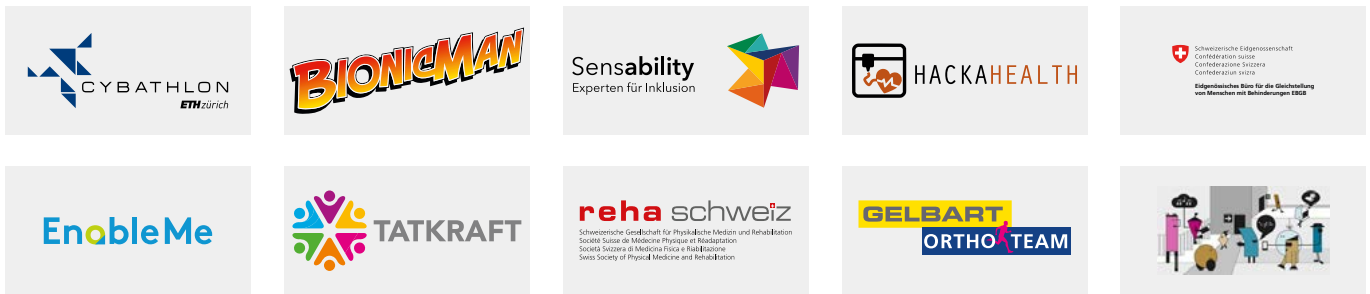Administration

Sabina Eipe
Administration

Partners

Strategic partners

Knowledge partners

Start-up partners

Associated universities and clinics

Financial report 2022

Funding budget for RESC research and development programmes (multi-year)

Revenues	Donor / Third Party	Start	Duration (y)	CHF
	Uplift Fundraising (various)	2020	open	133,033
	Swiss Paraplegic Foundation[1]	2021	5	1,000,000
	Uplift Fundraising (various)	2022	one-time	130,000
	Suva	2022	5	1,000,000
	Innosuisse Flagship	2022	5	268,265
	Stiftung Cerebral	2022	open	5,000
	Total			**2,536,298**
Awarded / Transfer	Project / Recipient			
	Hackster (RESC Research Call 1)	2021	1.5	93,033
	FutureINg (RESC Research Call 1)	2022	one-time	130,000
	RESC Outreach Project "Exhibition"	2022	1	40,000
	RehabCoach (RESC Research Call 2)	2022	3	300,600
	pAIn-sense (RESC Research Call 3)	2023	1.5	192,900
	FMW (RESC Research Call 3)	2023	2	276,100
	Total			**1,032,633**
Balance				**1,503,665**

[1] Total donation is CHF 2.5 Mio (expected to be a total of CHF 5 Mio over 10 years). ≤40% of volume can be used for research programmes, ≥60% for the ETH research lab at the Swiss Paraplegic Centre.

2022 operational budget of the RESC Executive Office

Revenues		CHF
	ETH Zurich Executive Board	200,000
	ETH D-HEST Contribution	100,000
	RESC Member fees	32,000
	Carry over from 2021	166,892
	Total	**498,892**
Expenses		
	Personnel costs (incl. social benefits)	367,649
	Basic costs (IT, Repro, Office)	6,571
	Communications and PR	10,911
	Events, Seminars, Development	47,582
	Travel, Representation, Education	3,596
	Total	**436,309**
Balance	**Carry over into 2023**	**62,583**