Why we need cohorts and biobanks

Prof. Dr. Nicole Probst-Hensch
Head, Department Epidemiology & Public Health
Why do we need citizen cohorts?
Citizen cohorts for independent public health research: an integrated view on parallel pandemics

- NCDs
- Mental Health
- Infections
- Poverty
- Environment

Public Health research for evidence-based policy

Swiss TPH
Cohorts and Biobanks
A Public Health Task – A Public Health Research Infrastructure

1. Who stays healthy – who turns ill
   - **Long-term cohorts provide the evidence for successful primary prevention**

   There is a pressing need to put more emphasis on improving quality of life and less on extending life

   More emphasis will need to be put on primary prevention and health promotion through health-in-all-policies
Comparative Contribution of Different Risk Factors to Global Deaths

- ~7 Mio air pollution related deaths EACH YEAR
- vs
- ~7 Mio COVID-19 related deaths

New chemicals must be marketed without evidence on adverse long-term effects in humans - need for human biomonitoring for post-marketing surveillance and mixture effects

Landrigan PJ et al. Lancet Oct 2017
Exposom Science – Towards Improved Causal Inference


Systems epidemiology

Meet-in-the-middle concept—prospective biosampling

- Mixtures
- Cross-omics perturbations
- Imaging features
- Subphenotypes
- Comorbidities
- Effect Biomarkers

Oxidative stress and inflammation
Genomic alterations and mutations
Epidemiological factors
Altered microbiome
Altered intercellular communication
Endocrine disruption
Metabolical dysregulation
EXPANSE with SAPALDIA - a new era of epidemiological research
PI: R. Vermeulen; https://expanseproject.eu/

| 55 million cohort participants of **all ages** 12 countries – inkl. SAPALDIA |
| >25,000 biosamples for DNA methylation, transcriptomic, proteomic, microbiomics, chemical profiles – inkl. SAPALDIA |
| Linking exposome to cardiometabolic and respiratory health – inkl. SAPALDIA |

![Diagram showing Reference Exposome, Exposome Map, and Exposome Navigator with Swiss TPH and OMICs data](image)
2. Who carries what risk for a disease – who has preclinical disease?
- Long-term cohorts provide the evidence for the development of molecular and
digital screening and diagnostic instruments of public health utility

There is a growing need for a shift to value-conscious innovation instead of the
“progress at any price” attitude that has dominated biomedical innovation until now

The long-term utility and cost-effectiveness of innovations must be assessed
Biomarker Measured while Healthy: What Keeps Us Healthy?

Blood lipids and cardiovascular diseases

Neurofilaments as biomarkers for neuronal damage may become as frequently applied as cholesterol

Brain image patterns and Alzheimer's

The Lancet Neurology Publication
Pascal Benkert, PhD
Prof. Jens Kuhle
«The Death Valley of Healthy Citizens» in the «Bench-to-Bedside» Era

130 out of 215 Mio US$ Investments for U.S. Precision Medicine for 1 Mio Citizens “All of Us” cohort

November 2015

Implementation of the “Swiss Personalized Health Network” (SPHN) Initiative

Report of the mandated Core Project Group (CPG)

consisting of the following members:
Peter J. Meier-Abt (SAMS/chair), Ron Appel (SIB), Urs Frey (SNSF), Detlef Günther (ETHZ), Vincent Mooser (CHUV), Nicole Probst-Hensch (UniBas), Michael Röthlisberger (SAMS), Daniel Vonder Mühll (ETHZ)

submitted to SERI, approved by the Steering Committee on January 7, 2016

5) In a second phase, there is a need for a large healthy population based reference cohort. Thereby, coordination and interoperability with the planned HBCP is of utmost importance.

➢ In the absence of citizen cohorts & biobanks. Swiss Personalized Health research will remain marginalized and of unknown utility
Cohorts and Biobanks

A Public Health Task – A Public Health Research Infrastructure

3. How well are health care systems functioning?

- Long-term cohorts and evolving patient subcohorts provide the evidence-base for evaluating strengths and weakness of the health care system

What are the long-term consequences of delayed diagnosis of diabetes, hypertension, depression and genetic disorders?

What is the long-term effect of antibiotics over prescription?

Do health interventions improve population morbidity and mortality in the longer-term?

What is the long-term public health utility & cost-effectiveness of novel personalized drugs?
### Disease Detection in the Kosovo Public Primary Health Care System

*Obas, Gerold, Zahorka, Probst-Hensch, Front Public Health 2022*

<table>
<thead>
<tr>
<th>Condition</th>
<th>Undetected</th>
<th>Detected</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>752</td>
<td>19</td>
<td>771</td>
<td>76%</td>
</tr>
<tr>
<td>Diabetes</td>
<td>535</td>
<td>16</td>
<td>551</td>
<td>62%</td>
</tr>
<tr>
<td>COPD</td>
<td>638</td>
<td>45</td>
<td>683</td>
<td>11%</td>
</tr>
<tr>
<td>Depression*</td>
<td>604</td>
<td>93</td>
<td>697</td>
<td>10%</td>
</tr>
</tbody>
</table>

*Data from follow-up 3 (September 2020 - February 2021, n=679)*

- Prevalence of hypertension: 76%
- Prevalence of diabetes: 62%
- Prevalence of airflow obstruction: 11%
- Prevalence of depressive symptoms: 10%
Cohorts and Biobanks
A Public Health Task – A Public Health Research Infrastructure

4. How well does health-in-all-policy work?
   - Long-term cohorts provide the evidence-base for improving health promotion

What are entry doors and targets for health promotion in all policies:
- What do urban planners need to consider towards healthy city planning?
- What must policy makers consider for healthy and health promoting agriculture?
Competence Centre Urban Public Health

Cohorts as Living Labs – Remaining in Touch with Citizens over Time

Professorship Urban Public Health:
Collaboration with urban planning & architecture
Junior Professorship Agricultural Health

Swiss Farmer Cohort

Protective Factors & Risk Factors

Physical

Psychosocial

Biological

Chemical

Foto: Aleksandar Littlewolf, Freepik.com
Where does Swiss TPH cohort (relevant) research stand nationally?
Only Swiss-wide citizen cohort
- > 30 years of follow-up
- Basis and protocols for Swiss Health Study pilot
- First Swiss-wide genome
- ~40 Mio CHF research funds

Respiratory Diseases
- COPD
- Asthma
- Lung cancer

Cardiovascular Diseases
- Ischemic HD
- Heart failure

Diabetes

Other Chronic Diseases

Smoking
Nutrition
Physical activity
Occupation
Obesity
Reproductive/hormonal factors
Early life exposure
Social network
Psychosocial stress

Quality of life
Wellbeing

Respiratory parameters:
- Lung function
- Bronchial reagibility

Cardiovascular parameters:
- BP
- HRV
- PWV
- CIMT
- Hba1c

Health symptoms
parodontitis
aging
parameters

Methylation signals of exposure
Genetic susceptibility
Methylation signals of effect

SAPALDIA
Swiss TPH
Pathways from residential greeness to health - SAPALDIA

Residential greenness-related DNA methylation changes

Greenness estimates at home addresses

EWAS and DMR analysis

Genome-wide DNA methylation profiles

**Allergy**
Curated as 3736 CpGs previously associated with atopy or allergic sensitization
Enriched for:
- EWAS/DMR of greenness 30x30m cell
- EWAS/DMR of greenness 500m buffer

**Physical activity**
Curated as 361 CpGs previously associated with physical activity or exercise
Enriched for:
- EWAS/DMR of greenness 30x30m cell

**Allostastic Load**
Curated as 1675 CpGs previously associated with CRP, metabolic syndrome, blood lipids, impaired fasting glucose, insulin, obesity, renal function, blood pressure, or cardiac autonomic nervous system
Enriched for:
- DMR of greenness 30x30m cell
- EWAS/DMR of greenness 500m buffer

Residential greenness may have health impacts through allergic sensitization, stress coping, or behavioral changes

*Jeong et al Environ Int 2021*
Swiss TPH Cohort Activity as Part of Pandemic Preparedness

Corona Immunitas – A National Public Health Cohort Success Story

Impact of SARS-CoV-2 Virus

Impact of Containment Measures
Mental Health Trajectories during COVID-19 Pandemic in COVCO-Basel

Probst-Hensch, Jeong, Imboden, Lovison submitted

Depression score from July 2020 to December 2021 (k=3, p=3)

Estimated cluster trajectories
- Cluster 1-Highly affected (n=830)
- Cluster 2-Moderately affected (n=2235)
- Cluster 3-Unaffected (n=3331)

Composition of clusters by income groups

Clusters of trajectories

- Cluster 1
- Cluster 2
- Cluster 3

Income groups
- < CHF 6000
- CHF 6000 - 15000
- > CHF 15000

Swiss TPH
Estimated trajectories of average depression score by economic, health and social worries in Corona Immunitas Program.
Residential greenness and life satisfaction during COVID-19 pandemic in COVCO-Basel  
Jeong/Probst-Hensch SwissMedWkly in press
COVID-19 Pandemic and Health-Related Quality of Life in Swiss Primary Schoolchildren

*Bringolf, Hänggi, Probst-Hensch Swiss Med Wkly 2021*

SOPHYA cohort on objectively measured physical activity in Swiss children

Coefficient and 95% CI 2014/15 ■ Coefficient and 95% CI 2020 (year of the COVID-19 pandemic)
Swiss TPH Citizen Cohort Relevant Expertise

- Exposom research urban-rural
- Biostats & mathematical modelling
- NCDs & infections

- Health systems/economics research
- Social science research
- Diagnostics
- Molecular science

- Cohorts/biobanks
  Local to national to global
Swiss TPH Citizen Cohort Infrastructure in Basel

Epidemiological Lab
Mobile Clinic

- Building on 30 years of SAPALDIA biobank expertise
- Experienced staff
- Broad vision
- Public Health partnership
- Broad academic and clinical partner network

Biobanking Infrastructure in Close Proximity to Epi Lab & Biosampling

- State-of-the art infrastructure
- State-of-the art sample processing
- Proximity to biosampling
- High quality biospecimens
Swiss TPH

Public Health united for a large Swiss citizen cohort
Switzerland is not able to contribute a sufficiently large cohort to the international cohort and biobank research community consortium as of today. In the era where health data is the “new gold”, this will jeopardize the scientific and also digital and economic success of the country

Switzerland needs its own large scale cohort

For **Swiss citizens** to benefit directly from high-quality research for health and wellbeing
For the **Swiss policy makers** for evidence-based health- and wellbeing related policies
For **Swiss researchers** to be internationally competitive
For **Swiss academic career promotion** in various research domains including digital and e-health
For **Swiss citizen science** to benefit from research conducted in close collaboration with citizens
For **Swiss public-private partnerships** to benefit from ample opportunities offered by a large citizen biobanks in life sciences and life science technology
Swiss Public Health Community: towards national citizen cohort as a research infrastructure

White Paper Swiss Cohort & Biobank

Nicole Probst-Hensch (Lead) *, Swiss TPH and Uni Basel; Murielle Bochud *, Unisanté, Uni Lausanne; 9 Luca Crivelli *, SUPSI & USI; Julia Dratva *, ZHAW; Antoin§e Flahault *, Global Health Institute, Uni 10 Geneva; Daniel Frey, Board Swiss Society for Public Health; Nino Künzli *, SSPH+ and Board Swiss 11 Society for Public Health; Milo Puhan *, EBPI Uni Zurich; L. Suzanne Suggs, USI *; Corina Wirth, 12 Swiss Society for Public Health
Roadmap Research Infrastructure IOP4CH
Imaging and Omics Platform for Swiss Citizen Health

Epidemiological Study Center
Biobanking Infrastructure
MRI and Ophthalmology Imaging Park