Challenges of Personalized Health for Clinical Medicine

Peter J Meier-Abt
Swiss Academy of Medical Sciences (SAMS)
Berne, Switzerland
Personalisierte Medizin – Personalisierte Gesundheit
Personalised medicine is a strategy to prevent, diagnose, and treat disease so as to achieve an optimal result for the individual."

*Meyer UA, Clin Pharmacol Ther 91, 373, 2012*
Individualized Drug Therapy

Genetic Factors

Personalized Medicine

Patients treated with a specific drug

- Adverse effects
- Poor responders
- Good responders

Genomic Medicine

- Pharmacogenomic studies
- AA genotype
- AT genotype
- TT genotype

- Drug X-AA
- Drug X-AT
- Drug X-TT
Drug Elimination by Liver and Kidneys

Drug-metabolizing Enzymes
Pharmakogenetics of CYP2D6

In vivo:

Extensive Metaboliser (EM)

Poor Metaboliser (PM)

Anzahl Personen

Ultra rapid metabolism

Metabolischer Quotient

Nortriptylin (mg)

>500 ~500-200 150-100 50 20-10

Extensive metabolism

Cutoff

Poor metabolism
Genome Based Personalized Cancer Therapeutics
A Two Pronged Approach - The One Two Punch

- Tumor harvest
  - Prepare
    - (a) Autologous tumor vaccine eliminating immune suppressive factor
    - (b) Immune boosters
  - Tumor biopsy
    - Identify
      - (a) Tumor vulnerable targets
      - (b) Drug sensitivity
      - (c) Immune suppressive factors
  - Prescribe
    - (a) Vulnerable target knockdown RNAi combinations
    - (b) Targeted drugs
    - Bioinformatics Analysis
      - Cancer Genomes
        - (a) Mutations
        - (b) Deletions and Insertions
        - (c) Rearrangements
        - (d) Epigenetic modifications
      - Cancer Transcriptomes
        - (a) Up and down regulated gene transcripts
        - (b) Non-coding RNA expression profiles
      - Cancer Proteome
        - (a) Protein expression level
        - (b) Post-translational modifications
Moleculargenetic Variants of Colon Carcinomas

The Future of Genetics in Our Everyday Lives

Live better, together!™
Making healthcare better for everyone through sharing, support, and research

Join now
Changes of personal habits after receiving genomics results

**TAKING ACTION**

After receiving genomics results, 42% of 1,051 surveyed people reported positive changes in their health behaviour. Only 1% of all respondents altered a prescription treatment without consulting a doctor.

- Dietary patterns: 72%
- Exercise habits: 61%
- Supplements: 17% with medical consultation, 21% without medical consultation
- Non-prescription drugs: 10% with medical consultation, 7% without medical consultation
- Prescription drugs: 11% with medical consultation, 2% without medical consultation

**Source:** Preliminary data from PGEN study, 2012-13

*Many respondents reported more than one change, so percentages total more than 100%.*

*Nature 505, 286–287, 2014 doi:10.1038/505286a*
Genetic and Acquired Causes of Diseases

- Age
- Sex/Gender
- Life Style
- Social Status
- Nutrition
- Drugs
- Genetic Factors

Disease
(Risk, Type, Prognosis Therapy)

Epigenetics

„inherited factors“

„acquired factors“
Epigenetics

“Heritable changes in gene expression that are not due to changes in DNA sequence“ (*transcriptional and post-transcriptional gene silencing*)

A common theme to disease epigenetics is the disruption of phenotypic plasticity – the ability of cells to change their behaviour in response to internal or external environmental cues.
Vision “Personalized Health”

The scientific roots: Genotype- Networks- Phenotype

Genotype

Molecular networks

Environment

Epigenome

Phenotype
The Measured Life

Who has Access to the Personal Data??

Die Vermessung des Ichs:
Prozentsatz der Deutschen, Franzosen und Briten, die Apps nutzen, um Daten aus ihrem Alltagsleben zu erfassen und auszuwerten.

Gesundheit 62%
Gesundheit 40%
Gesundheit 73%

Kalorienzufuhr 53%
Kalorienzufuhr 32%
Kalorienzufuhr 57%

Persönlicher Energieverbrauch 59%
Persönlicher Energieverbrauch 61%


Fitness Tracker

Log

Who has Access to the Personal Data??

Teilnehmer Umfrage: n = 1000 / Land

Quelle: TNS
Copyright © 2017
Change in Paradigm.....

„From Hypothesis to Data driven Research“

..... leads to Myriads of Association and Correlation Studies !?
„Correlation does not imply causation“
„Correlation does not imply causation“
Journals unite for reproducibility

Marcia McNutt

“…scientific journals are standing together in their conviction that reproducibility and transparency are important…”

Science 346, 679, 2014
Transforming Health Care Through Big Data

Strategies for leveraging big data in the health care industry

Clinical Bioinformatics !!!!
Vision: Integrated Personalized Health Platforms between University Hospitals and Universities/ETH

**University (or other Research) Hospital**

- **Clinical Research**
- **Biobanking**
- **Clinical Bioinformatics (clinical data)**
- **Translational Research Platform**
  - « Personalized Health »
  - Technology (*omics, IT, BIX)
- **IT- Infrastructure/computational expertise**
- **University/ETH or other Research Institutions**

(modified from V. Mooser)
Vision: Swiss Personalized Health Network (sPHNet)

Interdisciplinary Steering Board
(Central Administration Office)

Data storage, data mining, data reconstitution ....

International communication and coordination

ELSI

Interdisciplinary Steering Board
(Data) Coordinating Center

National Coordinating Center

Data storage, data mining, data reconstitution ....

International communication and coordination

Translational Research Platform
Technology (*omics, IT, BIX)

Clinical Research

Biobanking

Clinical Bioinformatics (clinical data)

Translational Personalized Health Platforms at University Hospitals

Swiss TPH

As part of the Swiss TPH, the Leiman Center for Personalized Health is a central hub for personalized health research.

ETHZ

Luzerner Kantonal Spital

CSCS

Erlanger Universitaet

UNIBE

University of Bern

Universita della Svizzera Italiana

Centre for Bioclinical Innovation

A collaborative network

Global communication and coordination

Translational Research Platform
Technology (*omics, IT, BIX)

Clinical Research

Biobanking

Clinical Bioinformatics (clinical data)

Swiss TPH

As part of the Swiss TPH, the Leiman Center for Personalized Health is a central hub for personalized health research.

ETHZ

Luzerner Kantonal Spital

CSCS

Erlanger Universitaet

UNIBE

University of Bern

Universita della Svizzera Italiana

Centre for Bioclinical Innovation

A collaborative network

Global communication and coordination

Translational Research Platform
Technology (*omics, IT, BIX)

Clinical Research

Biobanking

Clinical Bioinformatics (clinical data)

Swiss TPH

As part of the Swiss TPH, the Leiman Center for Personalized Health is a central hub for personalized health research.

ETHZ

Luzerner Kantonal Spital

CSCS

Erlanger Universitaet

UNIBE

University of Bern

Universita della Svizzera Italiana

Centre for Bioclinical Innovation

A collaborative network

Global communication and coordination

Translational Research Platform
Technology (*omics, IT, BIX)

Clinical Research

Biobanking

Clinical Bioinformatics (clinical data)

Swiss TPH

As part of the Swiss TPH, the Leiman Center for Personalized Health is a central hub for personalized health research.

ETHZ

Luzerner Kantonal Spital

CSCS

Erlanger Universitaet

UNIBE

University of Bern

Universita della Svizzera Italiana

Centre for Bioclinical Innovation

A collaborative network

Global communication and coordination

Translational Research Platform
Technology (*omics, IT, BIX)

Clinical Research

Biobanking

Clinical Bioinformatics (clinical data)
From the Lausanne Institutional Biobank (BIL) to the Swiss Biobank Platform (SBP)

V. Mooser and Chr. Currat, Swiss Med Wkly. 2014;144:w14033
Data Management Hierarchy for Personalized Health related Research

**Primary level:**
Collection of molecular, clinical and personal health data from patients and/or healthy citizens (heterogenous data sources)

*Personal data: Identifiable*

**Secondary level:**
Standardized data storage & management in the local/regional Personalized Health platforms at University Hospitals

*Personal data: De-identified or encrypted*

**Tertiary level:**
Aggregated and analyzable data for Personalized Health related research, innovation and health care purposes

*Personal data: Anonymized*
Request for a Nationwide Harmonized General Consent Procedure for Use of Biological Material and Health-Related Personal Data for further Use for Research.

For further use for research of biological material sampled or health-related personal data collected we need a nationwide harmonized interinstitutional General Consent procedure that can be taken at the first contact of each individual with the health system in Switzerland.

To Master New Challenges!
Components of the Swiss Personalized Health (PH) Initiative

Swiss Personalized Health Network (sPHNet)

Interdisciplinary Steering Board

Central Administration Office

ELSI Advisory Board

(Data) Coordinating Center

Local/Regional Translational PH Platforms at University Hospitals & Partners: Other Hospitals; General Practitioners; Healthy Citizens.

- Clinical Research
- Biobanking
- Clinical Bioinformatics
- Big Data mining etc.
- Education/Training

PH Biomedical Resource (PHBR) (nationwide coordinated bio- and data banks)

Research Projects (bottom-up defined)

Potential Priorities:
- Cancer
- Microbiomics
- Rare diseases
- Comorbidities
Thank you for your attention!