SAP HANA in der medizinischen Forschung

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Personalized medicine is a paradigm change

Understand and target the biological root cause

FROM
• Descriptive
• Outcome based diagnosis
• Organ based
• Retrospective diagnosis
• Limitations for epidemiology
• Acute care
• Treatment for the „average“ patient

TO
• Understand the disease mechanism
• Molecular diagnostics
• Fine molecular profile based groups
• Prospective diagnosis / Predisposition
• Environmental factors
• Prevention and early detection
• Individualized treatment
Concept of traditional medicine

**Current paradigm:** Symptoms + Vital signs ➔ Judgment + Expertise ➔ Gold standard treatment

- High fever, cough, etc ➔ Infection
- Antibiotics ➔ High success rate
However, for complex diseases the traditional approach is imprecise.

Biology is complex, therefore most diseases are complex.

Lumps in breast → Breast Cancer

Lumpectomy & Radiotherapy

Low success rate, but sometimes effective → Why?
Concept of traditional medicine

Treatment for the „average“ patient is not effective for several subgroups
Concept of personalized medicine

A new approach: Determine individual root cause

Targeted treatment

Gene Panel

BRCA1/2

HER2+

Breast Cancer

Personalized prevention

Personalized treatment

Better, but not perfect

Our understanding is incomplete
Concept of personalized medicine

As our understanding improves, therapy will become more individualized

- Precise analysis of disease cause
- many different subtypes
- Individualized treatment
- High response rate
The challenge: handle biological complexity

Molecular root cause > Personalized prevention, diagnosis and treatment

- 3.3 billion base pairs (haploid)
- 3-4 million variants per individual
- ~20000 protein-coding genes
- ~10,000 genetic disorders (WHO)
- >5,000 known disorders (OMIM)

- 53,000 non-coding RNAs
- 7.6 TB raw proteome data on ProteomicsDB.org
- 160 million data points (2.4 GB) per sample
- 10000+ protein variants
- 10000s of cellular reactions
- Millions of compounds targeting proteins or protein complexes

- Amino acids, sugars, etc.
- DNA
- mRNA
- Chromosomes
- Protein
- Genomics
- Transcriptomics
- Proteomics
- Microbiomics

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Why is it relevant?

Low treatment efficacy

Cancer: 75%

Alzheimer’s: 70%

Arthritis: 50%

Diabetes: 43%

Depression: 43%

Percentage of patients for whom drugs are ineffective.

Source: Paving the way towards personalized medicine. FDA’s role in a new era of medical product development.
Why is it relevant?

High cost

People in the developed world work until the 10th of March to cover their health expenses

Source: World Bank
Many actors in healthcare – all work on their own

Patient centric information backbone and collaboration remains a major challenge
Make healthcare processes more efficient

Clinical systems: from time and data sink to easy access support and information gold mine

Radical improvement through
- Modern software engineering
- User-centered design
- New technologies

SAP Medical Research Insights
- Faster building and validation of hypotheses
- Patient cohorts and research
- Analytics (genome and patient data)
- Patient-trial matching

SAP Patient Management application
- Patient experience and clinical delivery
- Ability to drive operational excellence – from admission to bill

SAP Foundation for Health
- Enablement of personalized medicine
- Ability to analyze massive volumes of structured and unstructured data (from patients, clinical, omics, third-parties, and so on)
- Secure collaboration and sharing

Health Engagement
- Open environment for customers and partners to build care collaboration scenarios for:
  - Engagement of the care network
  - Motivation for behavioral change
  - Prevention and risk detection

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SAP Health Engagement Complements SAP Foundation for Health
Real World Data Capture for research, product development, and care

Providing **breakthrough capabilities** for healthcare and life sciences applications from SAP and its partners, while **reducing time to value and the total cost of ownership**.

**SAP Foundation for Health based on SAP HANA**

- Spatial
- Search
- Text mining
- Application and user interface services
- Stored procedure and data models
- Business function library
- Predictive analysis library
- Database services
- Planning engine
- Rules engine
- Genomics
- Integration services
- Healthcare integration services

Support for any device

Partner apps for healthcare and life sciences
SAP HANA Foundation for Health
Unite information, create and validate hypotheses, and contain costs

SAP Foundation for Health enables you to

- Quickly access and integrate Big Data from various sources (clinical data, lab data, omics, images, and so on)
- Run real-time advanced analytics for structured and unstructured data
- Tailor the system to your needs through openness and multiple deployment options
- Use industry standards to ensure security and data privacy

Trust results through full control of data and algorithms

SAP Foundation for Health is the underlying technology foundation for SAP Medical Research Insights and other personalized medicine applications.
SAP Medical Research Insights

Access and analyze diverse medical data

- **Analysis of Big Data**
  Analyze structured and unstructured data, including genomics, proteomics, and other omics data, in real time through user-friendly interface.

- **Real-world data analysis**
  Capture and explore longitudinal patient data with real-world evidence.

- **Ad hoc reporting**
  Enable ad hoc reporting by harmonizing data from many sources and by representing them in easily understood visualization options.

- **Secure platform to understand, predict, and decide**
  Analyze data and run scenarios easily for hypotheses building and validation, shaping (pre)clinical studies and delivery of new drugs, devices, and care.

Search interface – slice, dice, and dive deep into research and clinical data
SAP Medical Research Insights: Omics analysis

Explore omics data in real time

- **Deep-dive analysis**
  Explore the complete data set, such as a full genome, to base level within seconds in an interactive user interface.

- **Broad analysis**
  Integrate and access relevant data from public and clinical sources.

- **Generation and validation of findings**
  Draw reliable conclusions concerning variants to drive personalized medicine.

Genomic variant browser – get a visual impression of a human genome sequence
SAP Medical Research Insights: Patient cohort analysis

Search according to indications and patient pattern analysis – detect efficacy levels for specific patient populations

Build cohorts from large sets of patient data

- **Clinical and post-market studies**
  Investigate drug effectiveness for different medical traits.

- **Insights for trial strategy**
  Identify a disease’s root causes and validate research hypotheses for new trials.

- **Outcome-based approaches**
  Facilitate evidence-based outcome discussions with multiple stakeholders (pharma, hospitals, regulators, and payers).
SAP Medical Research Insights: Validated data and real-time analysis

Understand diseases faster

- **Validated data capture**
  Get trusted results through full transparency into how data is collected.

- **Real-time analysis**
  Explore medical statistics and clinical studies within seconds.

- **Flexibility**
  Change perspectives on how to slice and dice the data easily through a user-friendly interface.

Kaplan-Meier analysis – explore survival probability of different patient populations per cancer type or therapy
Clinical Genomics Services

Generate actionable genetic insights in a clinical setting

Enable physicians to determine pathogenicity of genetic variants
- Integrate genomic, clinical and wearable device data
- Efficient semi-automated genetic report generation
- Large scale genomic services enabled
- Workflow support: change alerts, knowledge sharing, audit trail, hand-overs and approvals

Feature highlights
- Functional annotation of whole genome sequencing data
- Patients like yours?
- Patient dashboard – workflow support
- Clinical history timeline
- Interactive filtering and ranking of genetic variants
SAP & Stanford – Genomics

Goals of the collaboration

• Human genetic variation
• Large cohort studies to find associations between genetics & disease

Genetic basis of cardiovascular disease

Current projects:

• Stanford Clinical Genomics Service: pilot of genomic & clinical data integration
• Elite athlete project (~200 clinical exomes): Eligibility based on extremely high oxygen uptake as measured by V02Max (>75ml/kg Men; >63ml/kg Women)

Additional use cases:

• Lean Genome Data model
• Live genome annotation
Innovative re-use of electronic records with structured and unstructured data in the fields of:
- data semantics
- biomedical terminology
- natural language processing
- big data management
- predictive content analytics
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