From Functional Genomics to Systems Medicine: Uniting Worldwide Efforts into a Joint Collaboration

Biohealth Computing Roundtable on Big Data and Healthy Living

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CNRS-EISBM EU Projects in Rhône-Alps

- **Structuring Effect on Regional and European Levels**

**U-BIOPRED** - 24 M€ (2009-2014)
Unbiased BIOmarkers for the Prediction of Respiratory Disease outcomes
40 partners Including 10 big pharma
▶ IMI exemplar project

Developing and Deploying a European Translation Information & Knowledge Management Service Infrastructure
6 partners (academics+SMEs) +10 big pharma EFPIA
▶ Deliver Knowledge Management Platform
▶ Structuring effect for IMI, FP7 and Horizon 2020

**MedALL** - 14 M€ (2010-2014)
Mechanisms of the Development of ALLergy
23 partners (academics + SMEs)

**AirPROM** - 16 M€ (2011-2016)
Airway Disease PPredicting Outcomes through Patient Specific Computational Modelling
33 partners (academics + SMEs)

**SysCLAD** - 4 M€ (2012-2014)
Systems prediction of Chronic Lung Allograft Dysfunction
8 partners (4 academics, 4 SMEs)
▶ Based on existing lung transplantation cohort

**Synergy-COPD** - 5 M€ (2011-2016)
Modelling and simulation environment for systems medicine (Chronic obstructive pulmonary disease -COPD- as a use case)
8 partners (academics + SMEs)

**CASyM** - 4 M€ (2012-2016)
Coordinated roadmap to implement Systems Medicine across Europe
23 partners (academics, SME, industry, hospitals, government, patient org)

**HIGHLIGHT** - 3 M€ (2012-2016)
Highlighting EU-funded Health research results via TV media and the Internet
6 media partners

**SysPatho** - 3 M€ (2011-2014)
Inserm Systems Biology of Hepatitis C infection
11 partners (9 academics, 2 SMEs)

**Lyonbiopole-EISBM**
Information and Knowledge Management Services (TRI Bioaster ICT platform)

**Network of Systems Medicine Centres** (Horizon 2020)

**Microbiome**
TRI (Bioaster experimental platforms)

**Strengthen involvement of clinicians and SMEs in Systems Medicine** (HCL, CHU Grenoble)

**Bioenergetics Exercise**
**CENS Nutrition**
- HPC is necessary and used already for processing large volumes of next-generation sequencing and imaging data, and for multi-scale integration and simulation of models of complex biological systems.

- HPC is necessary and used currently to support translational research, such as the tranSMART/eTRIKS platform of the pre-competitive public-private partnerships of the Innovative Medicines Initiative.

- The ethical and regulatory landscape needs consolidation based e.g. on the Convergence Initiative and the Code on Secondary Use of Patient Medical Information in Collaborative Scientific Research.

- Adoption of Open Consent, Open Standards and Open Data sharing policies is needed and essential to ensure the best use of HPC to support Personalized and Health and Care Research in Horizon 2020.
Patient recruitment

Severe asthmatics:
Recruited from clinical centres across Europe

Sample collection

Multiple biomatrices:
- Plasma
- Sputum
- Urine

'Omics data acquisition

Biobank:
Sample shipping & storage

Knowledge management platform

Handprint of severe asthma

'Omics data integration:
networks, pathway mapping, statistical analyses
Collaboration Platform
- Collaboration
- Research process
- IP capture and management
- Secure access

Analytics Environment
- Access to analytics tools
- Open API for public and commercial software to plug-in

TR Knowledge Hub
- Cloud Infrastructure
- Load procedures
- ‘Big Data’ storage
- Ontology management
Platform and services for data staging, exploration, and use in translational research

Coordinator
Analytics
Managing Entity
Hosting
Standards
Coordination

www.etriks.org
Bio-clinical clusters in U-BIOPRED

Visualization of Data Structure Topology Data Analysis using Ayasdi Core
From Asthma to Allergy Dynamic Disease Maps

Metacore - Static

CNRS-EISBM-LCSB – AsthmaMap
Computerized and Dynamic
Participatory, Personalized, Predictive, Preventive Medicine

Systems medicine: the future of medical genomics and healthcare
Auffray C, Chen Z, Hood L (2009) Genome Medicine 1:2

Revolutionizing medicine in the 21st century through systems approaches

Systems biology and personalized medicine - the future is now

Quantifying your body: A how-to guide from a systems biology perspective
Smarr L (2012) Biotechnol J 7:980-991

Personal omics profiling reveals dynamic molecular and medical phenotypes

The road from systems biology to systems medicine
Participatory medicine: a driving force for revolutionizing healthcare
Monitoring Wellness, Health and Disease
Individual Dynamic Trajectories

- Personality survey
- Trait survey
- Lifestyle details
- Environmental details

Personal traits

- Physical activities
- Sleep patterns
- Blood pressure
- Biosensor
- Daily

Monitoring

DNA sequencing
- Whole-genome
- Blood samples
- Only one time

Biochemistries
- Blood chemistry
- Blood samples
- Every three months

- Gut microbiome
- Stool samples
- Every three months

Microbiome

Biomarkers
- Organ-specific blood markers
- Blood samples
- Every three months

n=1
Personal Sensors for Diet, Lifestyles and Exercises

- FitBit - Daily Steps & Calories Burned
- Zeo-Sleep
- MyFitnessPal - Calories Ingested
- Withing/iPhone - Blood Pressure
- EM Wave PC - Stress
- Nike+ FuelBand - 3-Axis sports-tested accelerometer, monitors activity as steps, calories.
- Apple and Nike - Smartphone applications collect data from sensors in fitness equipment.
- Azumio-Heart Rate

Prof. Philippe Sabatier
Monitoring Wellness, Health and Disease
Big Data Analytics

Data collection
- Sequencing
- Monitoring
- Microbiome
- Biochemicals
- Personal traits
- Biomarkers

Hosted and stored in total security
Health cloud center

Health information can be shared quickly and easily with all care providers
Introduction to Systems Biology Course – Joseph Fourier University of Grenoble and Ecole Normale Supérieure de Lyon

EISBM Annual Symposia and Workshops on Knowledge Management in Translational Research

From Experimental Medicine to Systems Medicine – Claude Bernard University of Lyon


Introduction to Systems Medicine Course – Grenoble Alps University (in preparation)
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