The gap between basic and clinical science

Patrick Aebischer
Info-nano-bio-cogno convergence

« Info-nano-bio-cogno » convergence, leading to a deluge of data

+ the capacity of information theory to extract meaning of big data
The cost of genome sequencing

Moore’s law

2012
Life Technologies
Ion Proton
$1,000/human genome?

Source: genome.gov/sequencingcosts
Wearable monitoring devices

- Glucose monitoring
- Cardiac Monitoring
- Mood Tracking
- Geolocalisation
- Sleep Monitoring
Lab on a chip + smart drug delivery

iPill Philips

Smart Pill
Proteus Biomed

Microfluidics / Lab on chip

The Aging Challenge
Digital Medicine – The Quantified Self

→ Welcome to the medical big data world
→ Behavior-based insurance premium
→ Measurement of drug compliancy
→ Privacy issue
Personalized or precision medicine

→ Sequencing of individualized genome + metabolome
→ Identification of predisposing genes and risk factors
→ Tailored prevention program (life style, nutrition, drugs)
→ Integrated biosensors (watches, glasses, contact lenses, clothes…): continuous recording of several bio-parameters and data
Gene editing with CRISPR/Cas9 technology

CRISPR/Cas9 finds and cuts (almost) any target gene in mammalian cells

Target gene

DNA break → gene inactivation or repair

Guide-RNA allows the introduction of specific DNA breaks
CRISPR/Cas9 technology

Gene Editing Human Diseases and Traits

Eliminate disease alleles from population: cystic fibrosis, Huntington’s disease + thousands of rare Mendelian diseases

Reduce disease risk: by introducing “better” gene variants for infectious diseases, cancer, heart disease

Enhance human population
- Introduce genes do digest fiber and cellulose
- Retinal receptors for infrared vision
- Desired traits (perfect pitch, height, muscle mass, etc.)
Bioprinting of spare parts

associated with iPS derived stem cells or autologous cells
How to fill the gap?

→ Train a certain % of MD with a technical background

→ Develop an integrated MD/PhD program

→ Develop closer links with clinicians

→ Dedicated space in hospitals (i.e. Agora)

→ Develop more interactions with companies interested in translating disruptive technologies (pharma, medtech, nutrition, big data etc.)

→ Stimulate the creation of start-up
An integrated premed program at the Lemanic level

Transition year ("passerelle")
Promising year for VC funding @ EPFL

Some examples of VC funding raised since the beginning of the year…

→ AB2Bio raised 21 M$
→ MindMaze raised 100 M$
→ G-Therapeutics raised 36 M€
→ AC Immune raised 44 M$
Biotech VC funding

Benchmarking 2015

→ New York State: ~ 256 M$
→ Massachusetts: ~ 2.0 B$
→ California: ~ 4.8 B$

« Arc lémanique » raised ~300 M$ since the beginning of the year

Source: FT, May 17th, 2016
Thank you for your attention
An integrated premed program at the Lemanic level

- Dès 2017
  - 25 étudiants
  - EPFL
  - BA Sci Bioméd
  - 15 autres
  - UniX
  - BA Sci Biol

- dès 2018 *
  - Passerelle UniL
  - 1 année
  - 40 étudiants

- Master Med UniL
  - 30 étud max

- Master Med Ing UniGE
  - 10 étud max

* 30 étudiants au départ

- UniGE, EPFL et Unil
  - Méthodes de simulation pour remplacer 10% du temps passé auprès des patients
  - Apprentissage de la télémédecine pour la méd de premier recours
Simulation-based medicine

Technology offers new opportunities

→ Singapore General Hospital
   Practice new technologies and advance procedures

→ Stanford Medicine
   Mannequin-based patient simulation, desktop simulations and virtual worlds, visualization and virtual reality

→ Realview
   3D holographic video or images “floating in the air”

→ SimX
   customizable, high-definition, 3D virtual patient
Towards the development of digital medicine

Electronic medical records

DNA sequencing

Social networks

Proteomic/metabolomic

Digital Medicine
CRISPR/Cas9 technology

Powerful gene editing technology

Synthetic biology: fuels, polymers etc.

Human Medicine

Agriculture: crops and animals