Präzision-Onkologie: Erfahrung für die ersten 1000 fortgeschrittenen Krebspatienten und was wir gelernt haben

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Leader, Center for Precision Medicine
Universität Bern and Inselspital, Bern, Switzerland
Weill Cornell Medicine, New York, NY, U.S.A.

@MarkARubin1

UNIVERSITÄT BERN

INSELSPITAL

Weill Cornell Medicine
Caryl and Israel Englander Institute for Precision Medicine

ProStars

Swiss Prostate Cancer Researchers

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Precision Medicine Enters into the National Health Care Dialogue

Obama to Request Research Funding for Treatments Tailored to Patients' DNA

By ROBERT PEAR

WASHINGTON — President Obama will seek hundreds of millions of dollars for a new initiative to develop medical treatments tailored to genetic and other characteristics of individual patients, administration officials say.

The proposal, which will be described in greater detail in his budget in the coming weeks. The effort is likely to

"This is an incredible area of promise," said Senator Bill Cassidy, Republican of Louisiana and a gastroenterologist. "There will be bipartisan support."

Mr. Obama called it precision medicine, but the terms "personalized medicine" and "individualized medicine" are also widely used to describe the evolving field in which, for example, a doctor prescribes a medication that targets a specific mutation in a patient's genes.

The money would support biomedical research at the National Institutes of Health and the regulation of diagnostic tests by the Food and Drug Administration, officials at the two agencies said.

The tests analyze the DNA in normal or diseased tissue. Doctors use that information to identify patients with cancer or other diseases who are most likely to benefit from a particular treatment — and those who would be harmed or not respond at all.

"In some patients with cystic fibrosis, [illegible] said in his address to Congress last [illegible] was discovered by a team that included Dr. Francis S. Collins, who is now [illegible] of the National Institutes of [illegible] initiative. The F.D.A. has approved a drug for patients with a genetic mutation responsible for some cases of the disease, which clogs the lungs with thick, sticky mucus.

A patient taking that drug, William Elder Jr., a 27-year-old medical student in Ohio, was a guest of Michelle Obama at the State of the Union speech.

Representative Fred Upton, Republican of Michigan and chairman of the Energy and Commerce Committee, and Representative Diana DeGette, a Colorado Democrat who is on the committee, welcomed Mr. Obama's proposal. After holding hearings and round-table discussions last year, they said they were drafting a bill to encourage biomedical innovations, including personalized medicine.

As a senator in 2006 and 2007, Mr. Obama offered a bill to do just that — the Genomics and Personalized Medicine Act. Senator Richard M. Burr, Re[illegible]

"Personalized medicine represents a revolutionary and exciting change in [illegible] Mr. [illegible] cited the drug Herceptin, for the treatment of a particularly aggressive form [illegible]

Scientists said they now viewed breast cancer not as a single disease, but rather as a group of several subtypes, each with a distinct molecular signature. This, they said, helps explain why some tumors respond better than others to specific cancer-fighting drugs.

"Most medical treatments have been designed for the average patient," said Jo Handelsman, associate director of the White House Office of Science and Technology Policy. "In too many cases, this one-size-fits-all approach is not effective."

Dr. Ralph Snyderman, a former chancellor for health affairs at Duke University, often described as the father of personalized medicine, said he was excited by the president's initiative.

"Personalized medicine has the potential to transform our health care system, which consumes almost $3 trillion a year, 80 percent of it for preventable diseases," Dr. Snyderman said.

Although the [illegible] and treat[illegible] personalized medicine can save money while producing better results. "It fo[illegible] [illegible]

support for hundreds of millions of dollars for 'personalized medicine.'

will work," he said. "You can avoid wasting money on people who won't respond or will have an adverse reaction."

The new techniques can also help prevent disease by predicting patients' susceptibility, Dr. Snyderman said. "If an individual has a much greater likelihood of developing colon cancer, a genetically based [illegible] said, "you can begin screening [illegible] age, 30 rather than 50, for example."

Dr. Margaret A. Hamburg, the F.D.A. commissioner, has reorganized her agency to speed the review of drugs and diagnostic tests used in personalized medicine.

[illegible] Senator Cassidy said he was still [illegible] of personalized medicine, he said, will require "a much more nimble federal bureau[illegible]

[illegible] released a proposal under which Medicare would cover genetic tests of tumors in some [illegible] cancer. The [illegible] are beneficiaries who would respond favorably to particular cancer drugs.

"This is a watershed event," said Dr. Bruce Quinn, a health-policy specialist at the law firm Foley Hoag. "It means that policy makers now believe these tests are worth paying for."

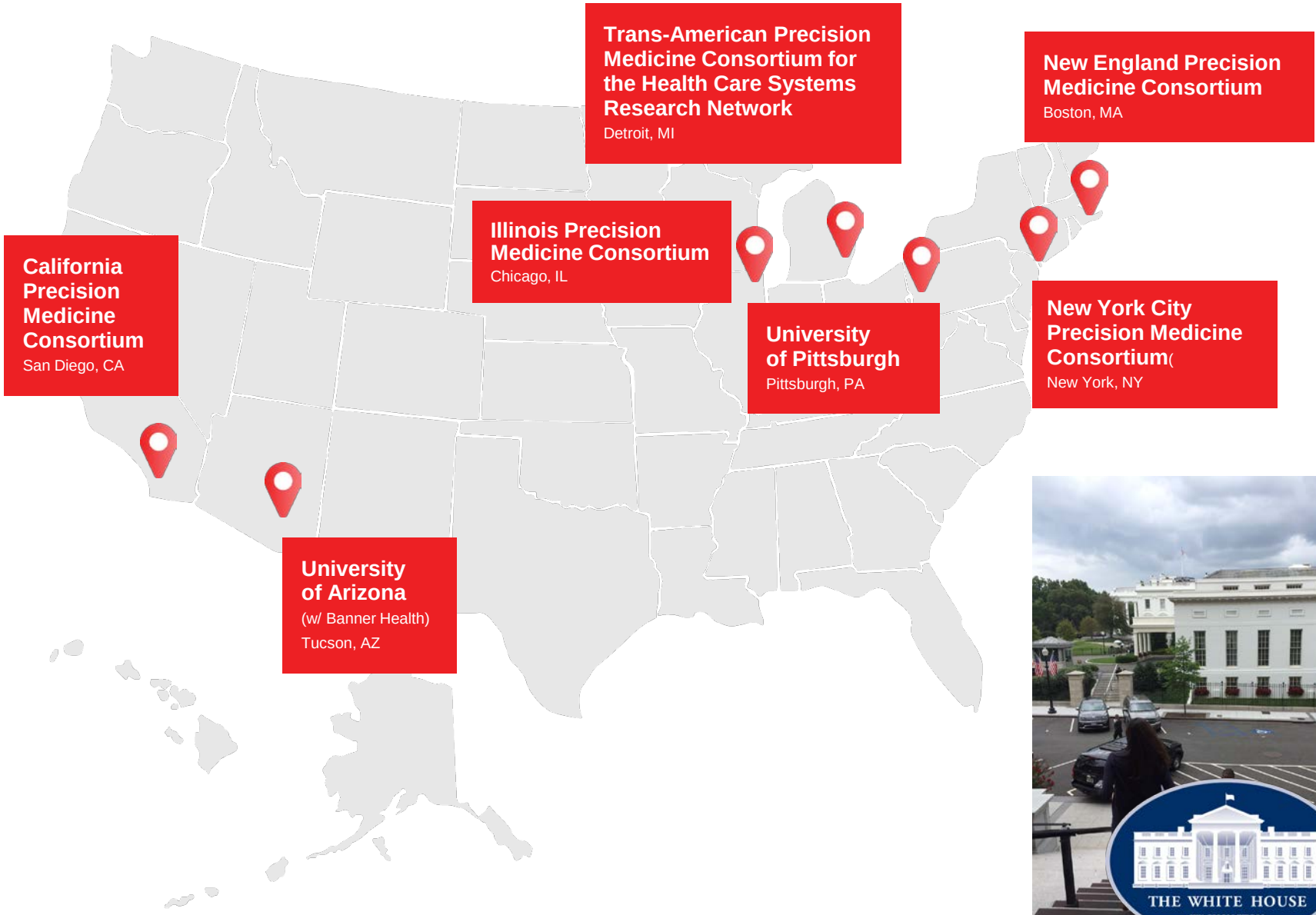
Mr. Obama's budget will also propose increased federal spending to combat antibiotic-resistant bacteria. The plan would nearly double spending from its current level of $450 million a year.

White House officials described antibiotic resistance as a threat to public health and national security. They said [illegible] people in the United States [illegible] each year as a result of infections caused by [illegible] germs.

President Obama will seek hundreds of millions of dollars for a new initiative to develop medical treatments tailored to genetic and other characteristics of individual patients.

NYT Jan 25 2015

HPOs: Regional Medical Centers (RMCs)



PRÄZISIONSMEDIZIN

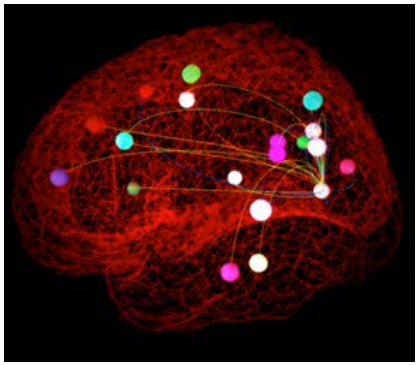
Präzisionsmedizin ist ein personalisierter Ansatz in der modernen Medizin, welcher individuelle Merkmale wie genetische Prädisposition, Umweltfaktoren oder Lebensstil der Patienten in die Behandlung miteinbezieht.

Die Initiative der UniBern / Inselspital in der Präzisions-medizin strebt an, dass die richtige Behandlung zur richtigen Zeit zum richtigen Patienten gelangt.

Kreismodell Precision Medicine

Big data transformiert die Wissenschaft...

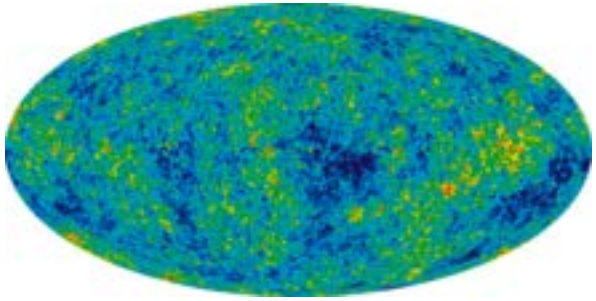
High energy physics -
Large Hadron Collider



Neuroscience -
The Human Connectome Project

Ecology - Fluxnet

Genomics
DNA sequencer

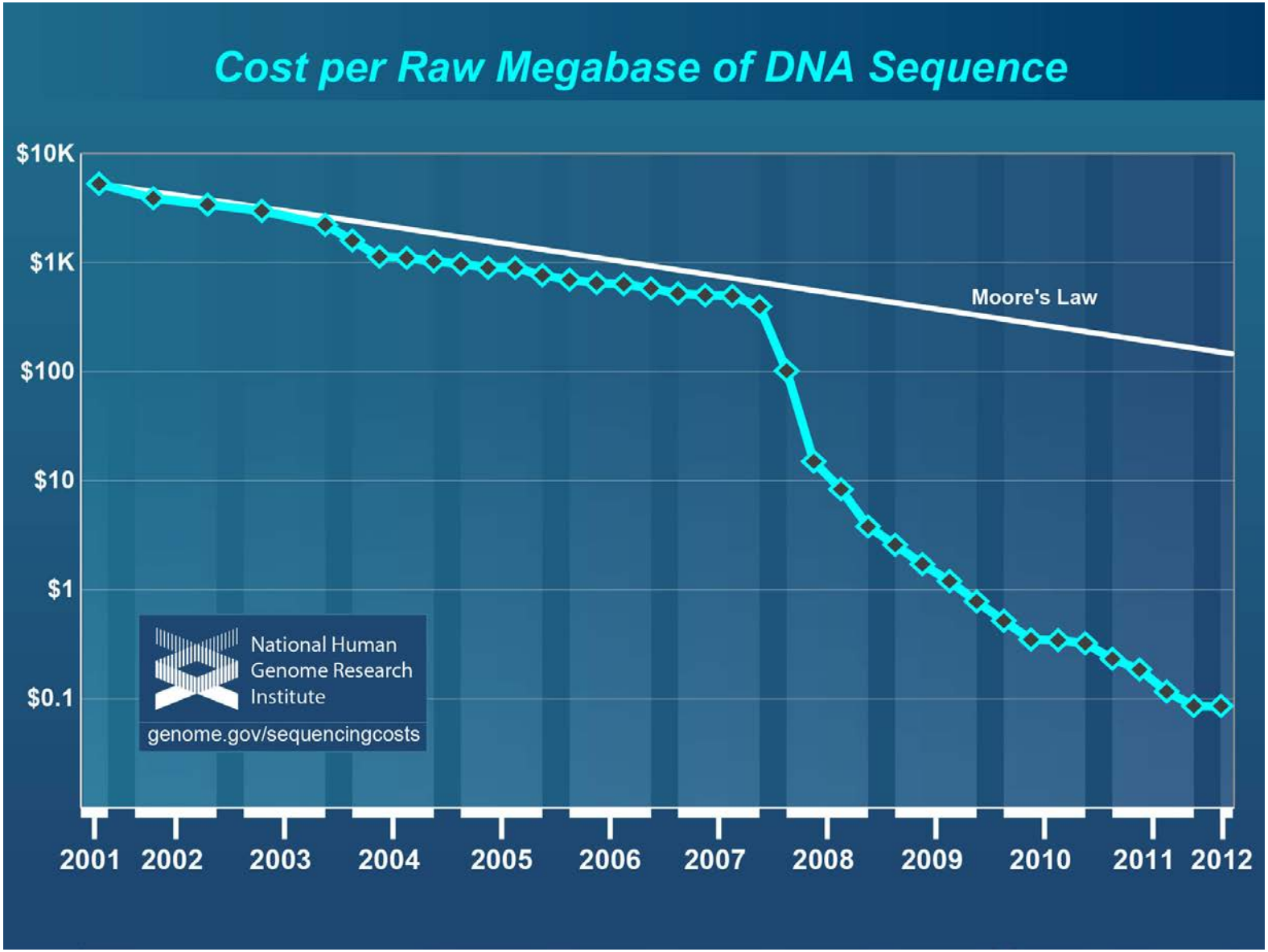


Astronomy -
Sloan Digital Sky survey

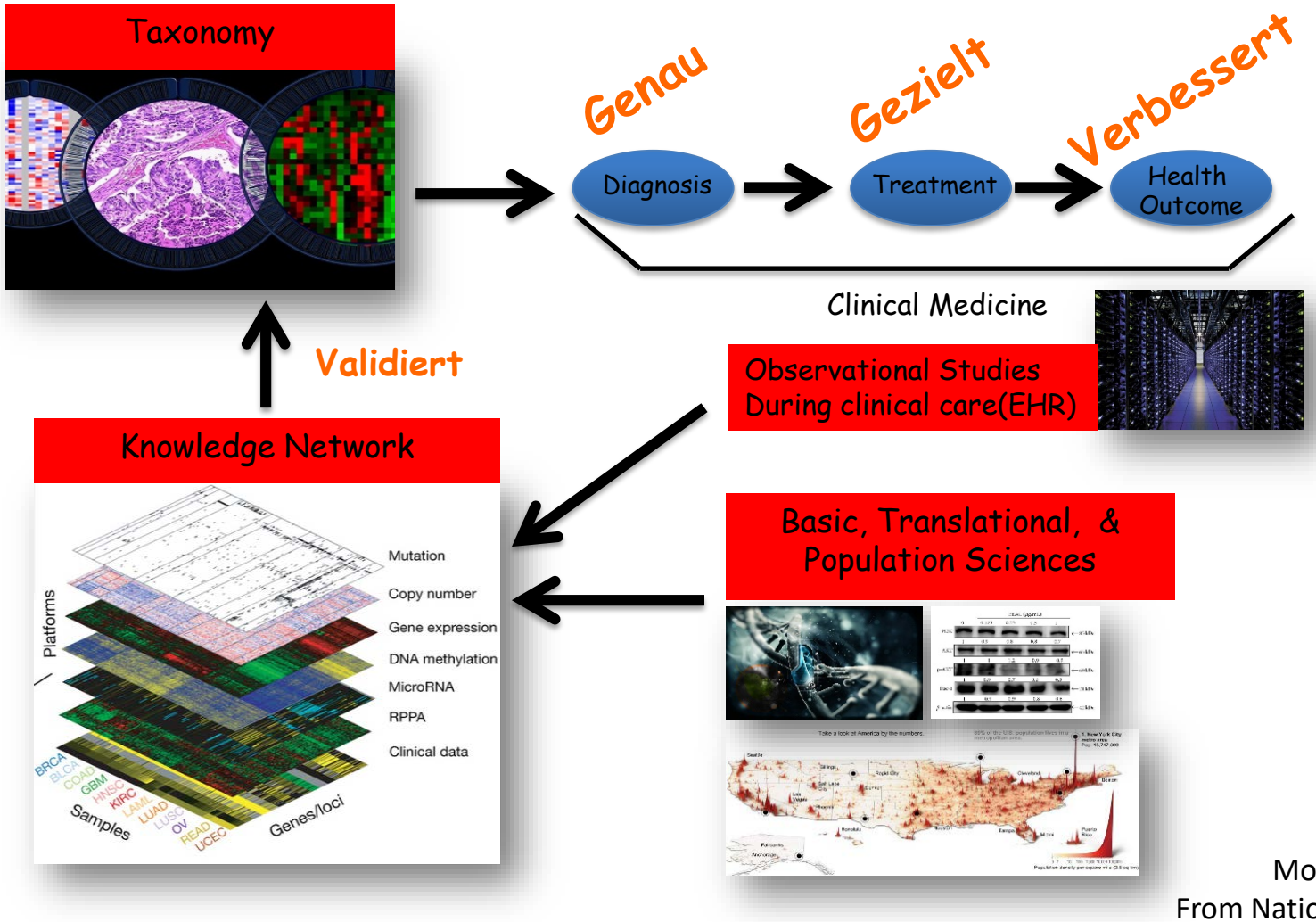
Knowledge of knowledge
Meta-data of scientific documents

ISI Web of KNOWLEDGE
Transforming Research

Datenexplosion in der Genforschung aufgrund sinkender Kosten



Das Versprechen und die Zukunft der Präzisionsmedizin

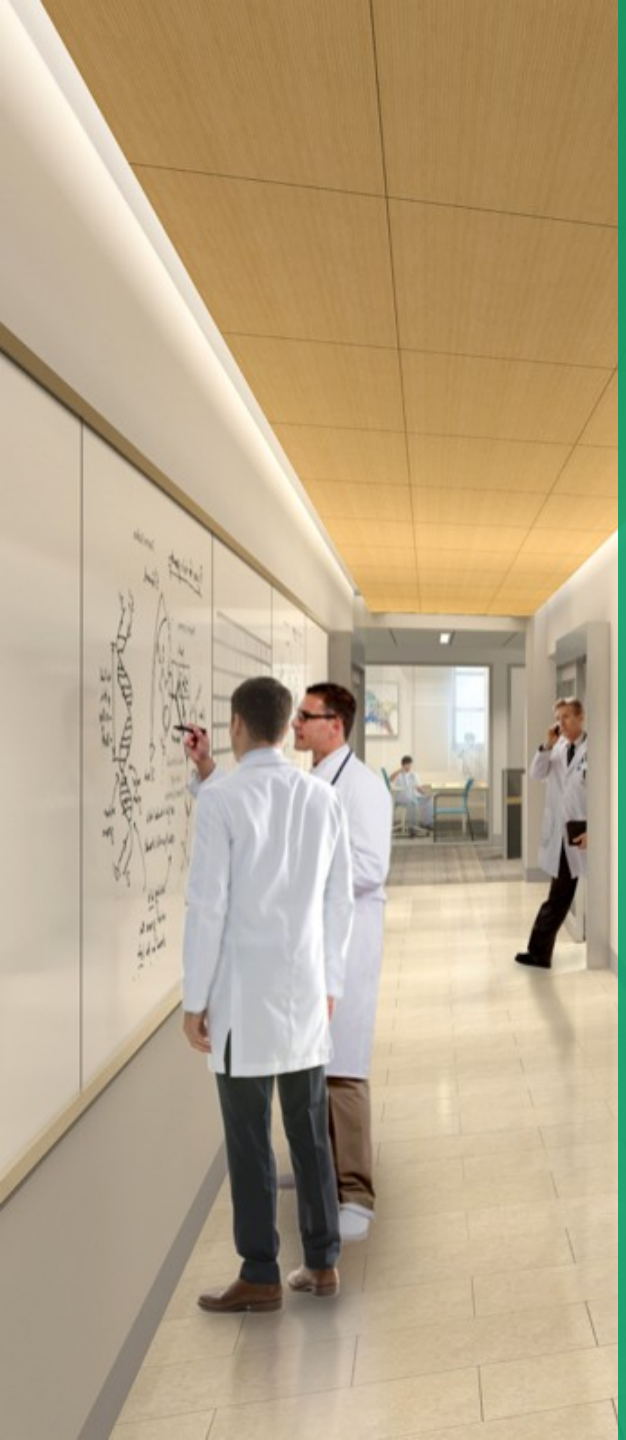


Modified
From National Academy
of Medicine

ZIEL

Eine kontinuierliche Pflege, in welcher wir den gesunden, kranken und wieder genesenen Zustand eines Patienten umfassend begleiten und erfassen - unabhängig der zugrundeliegenden Krankheit.

- Dies erlaubt uns, wertvolles wissenschaftliches Material zu sammeln, damit klinische Entscheide fundierter sind
- Um die Krankheit besser zu verstehen, brauchen wir Wissen über die Gesundheit
- Daten helfen uns nicht nur bei der Heilung von Krankheiten, sondern auch für die Erhaltung der Gesundheit



Z U S A M M E N A R B E I T

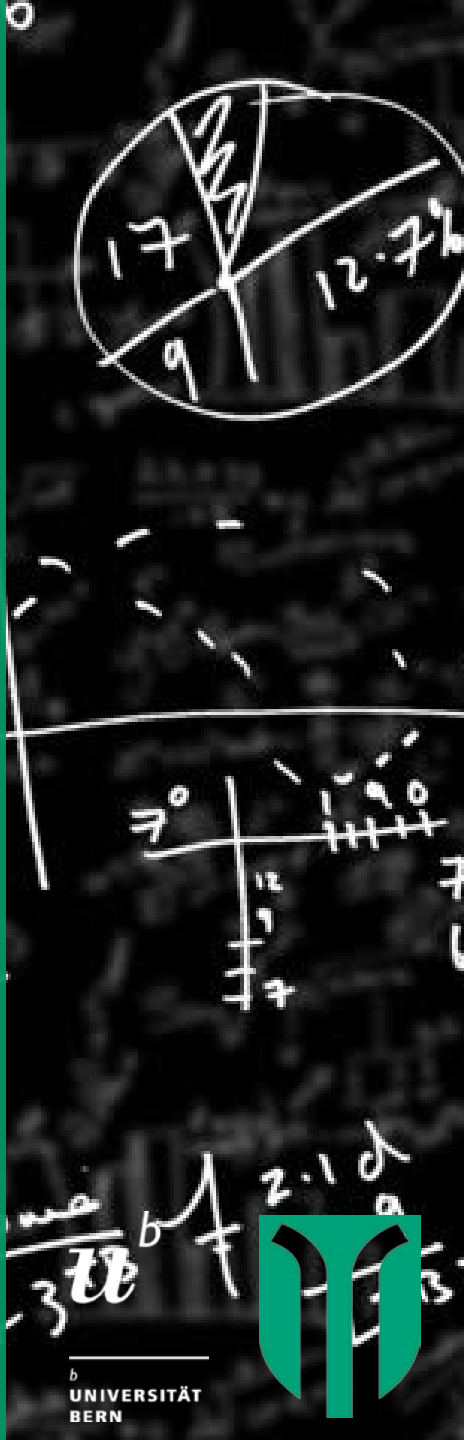
Präzisionsmedizin ist Teamwork – sie kombiniert die Kenntnisse und Fähigkeiten von ÄrztInnen, GenetikerInnen und DatenanalystInnen, um KlinikerInnen die besten Diagnose- und Behandlungsmöglichkeiten zu ermöglichen

- Teamwork heisst, wir arbeiten innerhalb von vielen unterschiedlichen Disziplinen, um eine möglichst grosse Expertise zu garantieren
- Aufgrund der riesigen Datenmengen aus genetischen Tests sind Bioinformatiker für unser Team essenziell
- Wir sammeln nicht nur Daten, wir nutzen sie und lernen aus ihnen

LERNSYSTEM FÜR DAS GESUNDHEITSWESEN

Wir schaffen ein Lernsystem für unser Gesundheitswesen, in dem die Behandlung aktiv überwacht und stetig verbessert wird

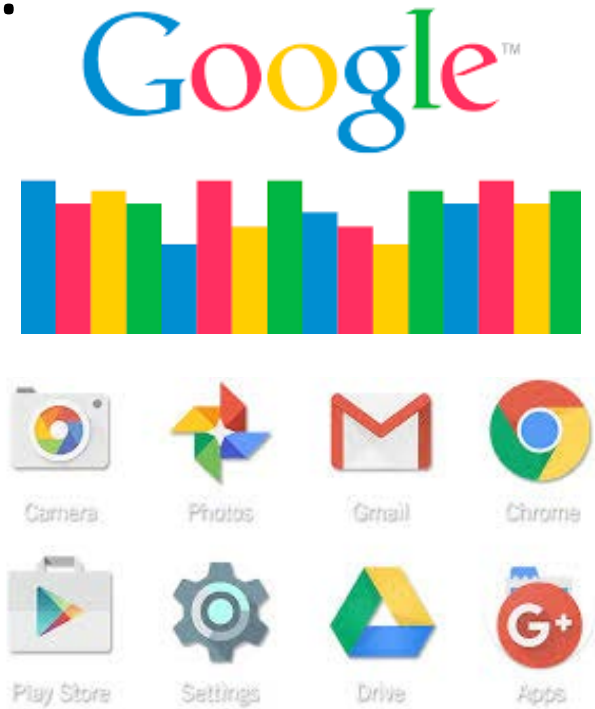
- Dies erlaubt uns, aktuelle Behandlungsstandards kontinuierlich zu verbessern.
- Die Verwendung von Genetik eröffnet völlig neue Wege zur Behandlung von Krankheiten
- Unser Ziel ist es, jeden Behandlungsplan eines Patienten so einzigartig zu gestalten, wie es auch das individuelle Genmaterial ist
- Wissenschaftliche Erkenntnisse werden direkt in die Ausbildung der ersten Generation von ÄrztInnen im Gebiet der Präzisionsmedizin einfliessen



Kreismodell Precision Medicine

Small data too..

Wo bist Du?
Wo warst Du?
Was kaufst Du?
Wie oft schreibst Du Emails?
Wieviel Leute wohnen bei Dir?
Was suchst Du im Internet? Wann? Wie oft?



Wieviel Angst sollten wir haben?

Bedeutung von genomischem Datenschutz

- **Das allgemeine Dilemma der genomischen Privatsphäre**
  - Aus dem Informationsaustausch wird die Person möglicherweise in ihrer **Privatsphäre beeinträchtigt**, aber die **Gesellschaft profitiert** von der medizinischen Forschung
  - *Wie kann man Risiken und Belohnungen ausgleichen?*

Modified from M. Gerstein, [D Greenbaum, M Gerstein (‘11). Am J Bioeth 11:39. Greenbaum & Gerstein, The Scientist ('13)]

An Introduction to the

All of Us Research Program

National Institutes of Health

Updated July 7, 2017

@AllofUsResearch #JoinAllofUs

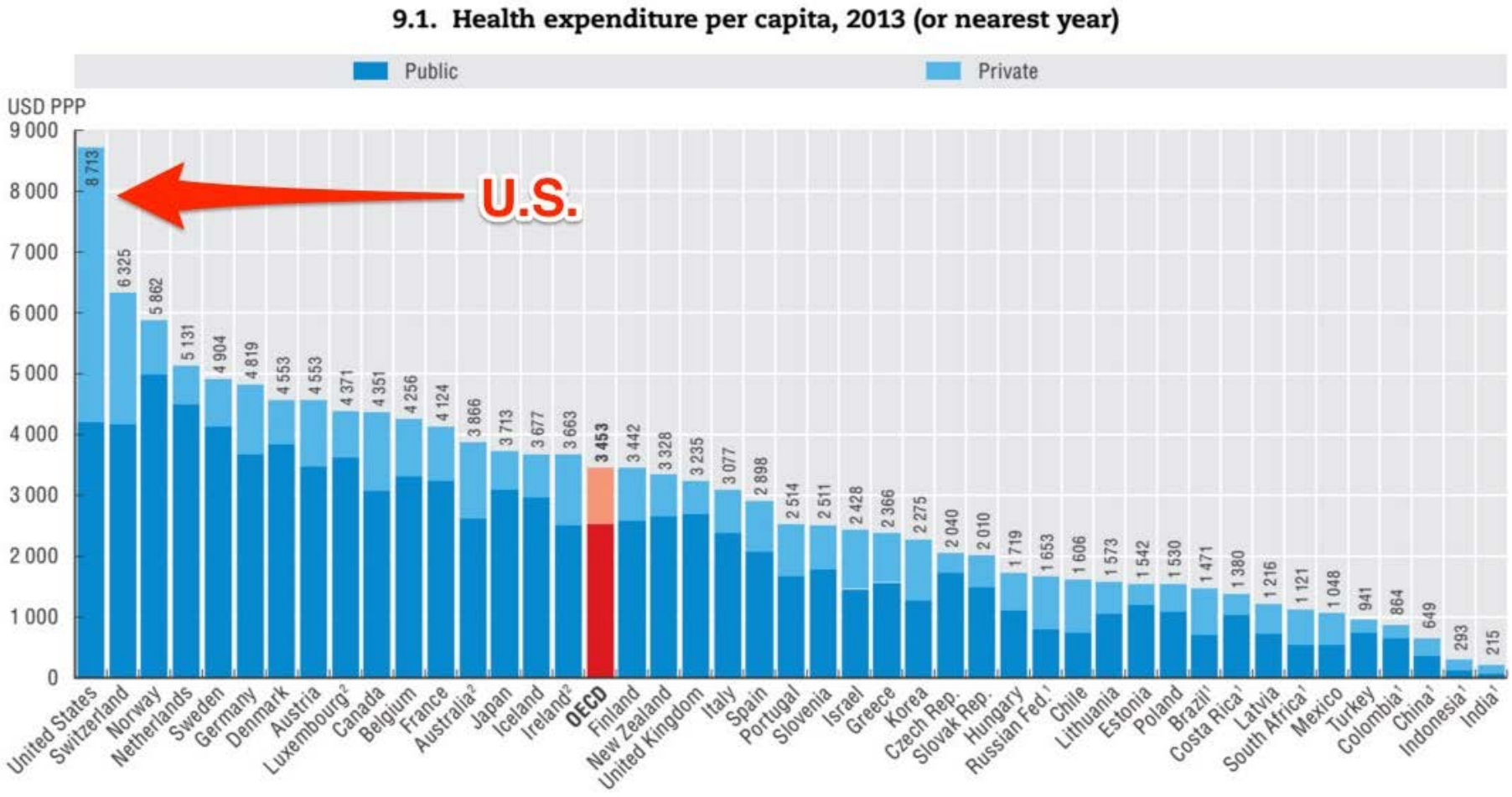
The Vision of President Obama

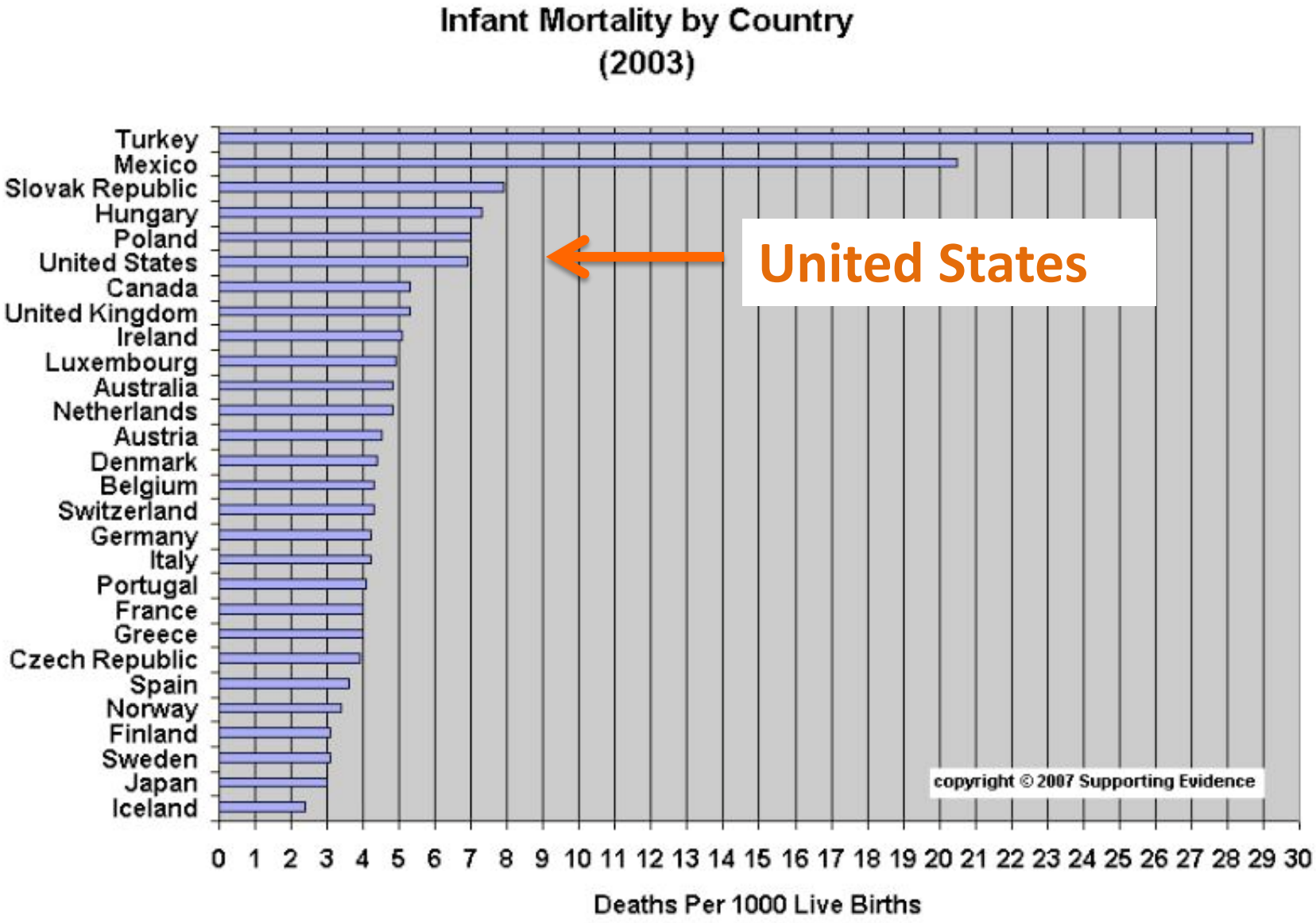
"My hope is that this becomes the foundation, the architecture, whereby in 10 years from now we can look back and say that we have revolutionized medicine."

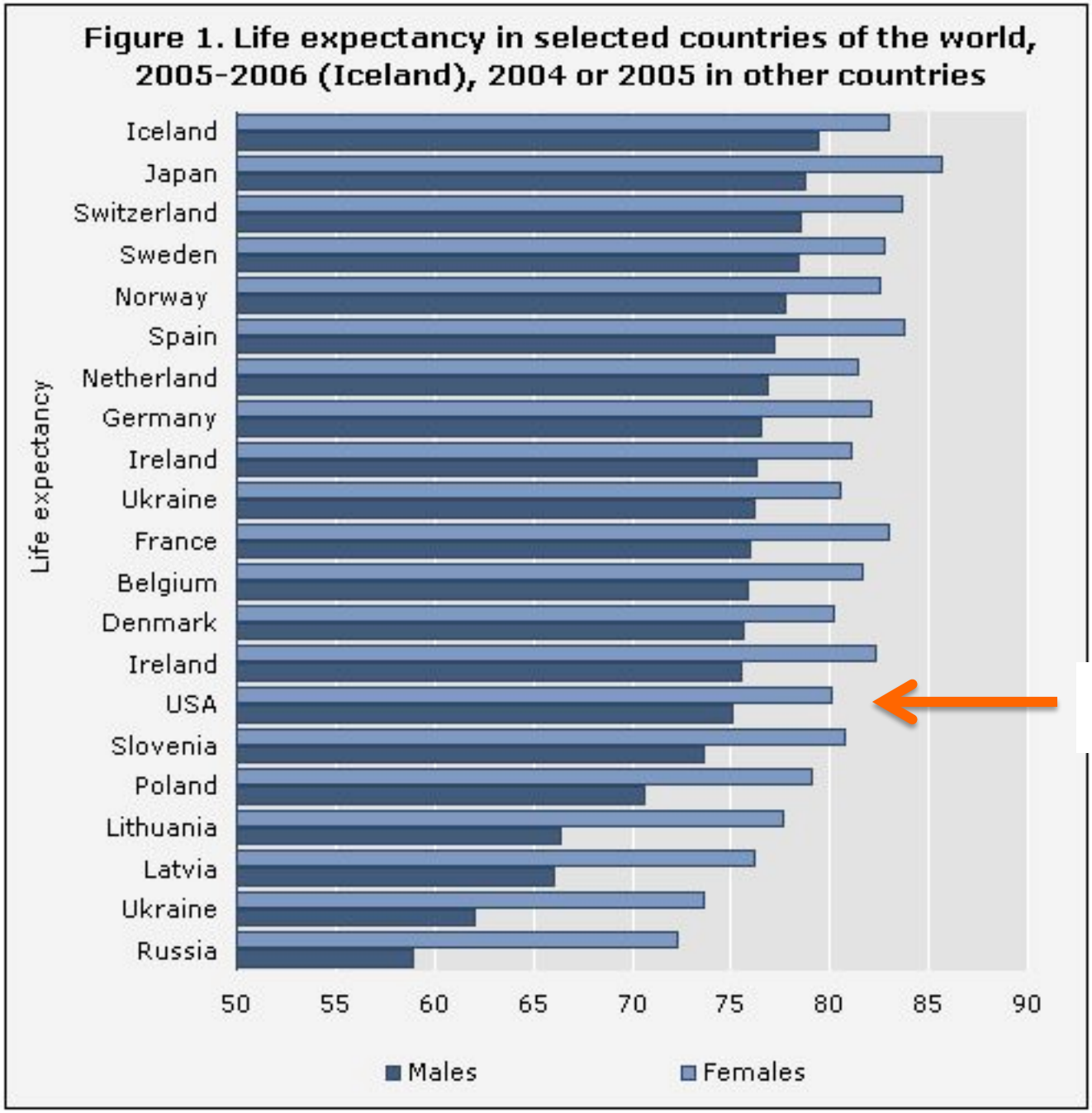
- President Barack Obama

US Spend Most on Health Care

Source: Organization for Economic Co-operation and Development




Infant Mortality by Country
(2003)
Turkey
Mexico
Slovak Republic
Hungary
Poland
United States
Canada
United Kingdom
Ireland
Luxembourg
Australia
Netherlands
Austria
Denmark
Belgium
Switzerland
Germany
Italy
Portugal
France
Greece
Czech Republic
Spain
Norway
Finland
Sweden
Japan
Iceland
United States
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Deaths Per 1000 Live Births
copyright © 2007 Supporting Evidence



United States

Etablierte Programminfrastruktur

DATA AND RESEARCH CENTER (DRC)

Big data capture, cleaning, curation, & sharing in secure environment

Vanderbilt, Verily, Broad Institute

BIOBANK

Repository for processing, storing, & sharing biosamples (35+M vials)

Mayo Clinic

PARTICIPANT CENTER

Direct volunteer participant enrollment, digital engagement innovation, & consumer health technologies

Scripps Research Institute (with multiple partners)

PARTICIPANT TECHNOLOGY SYSTEMS CENTER

Website & mobile apps for participants

Vibrent Health

HEALTH CARE PROVIDER ORGS (HPOs)

Clinical & scientific expertise network, enrollment & retention of participants

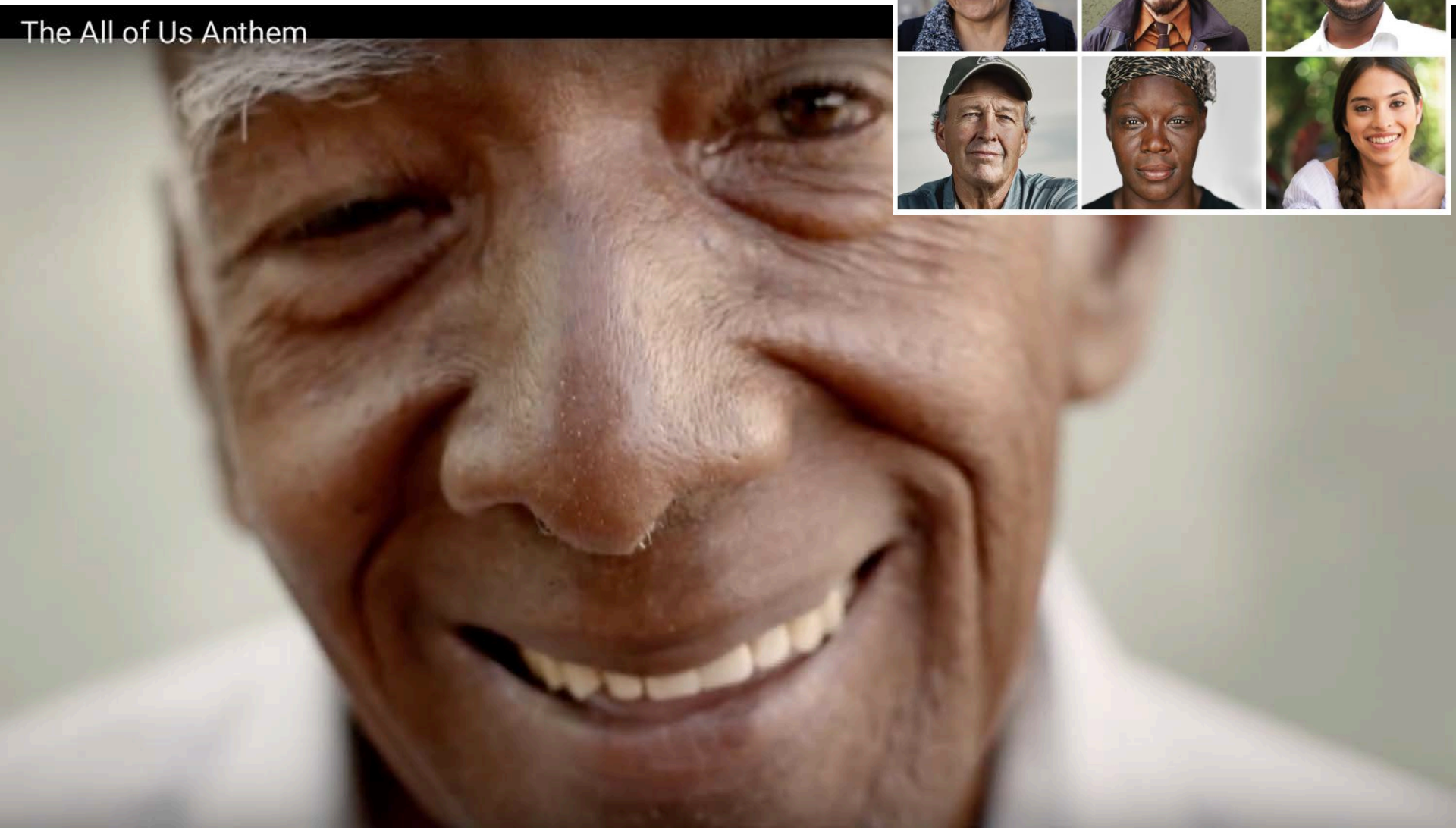
20+ regional med centers, FQHCs, VA, future awards to grow network

COMMUNICATIONS & ENGAGEMENT

Comms, marketing, & design expertise; engagement coordination & community partners network

Wondros, HCM, future awards to grow network of community partners

All of Us
Research Program



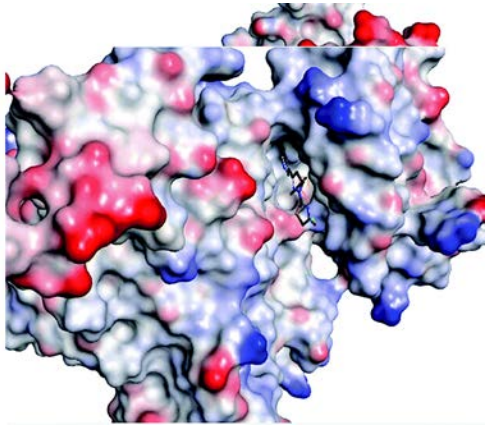
Der Nutzen der Teilnahme bei *All of Us*

- **Eine Gelegenheit** etwas über Ihre Gesundheitsindikatoren zu erfahren und Zugang zu Ihren eigenen Daten zu haben
- Eine Gelegenheit, **Krankheiten zu bekämpfen** und die Gesundheit zukünftiger Generationen zu fördern
- Eine Gelegenheit, **Teil einer Bewegung zu sein,** für eine präzisere, persönlichere und effektivere Gesundheitsvorsorge

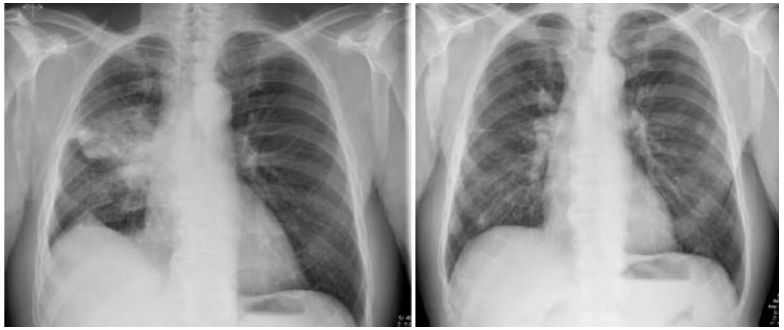
Präzisionsmedizin: Lehren aus dem Feld

Präzisionsmedizin: Lehren aus dem Feld

Drug

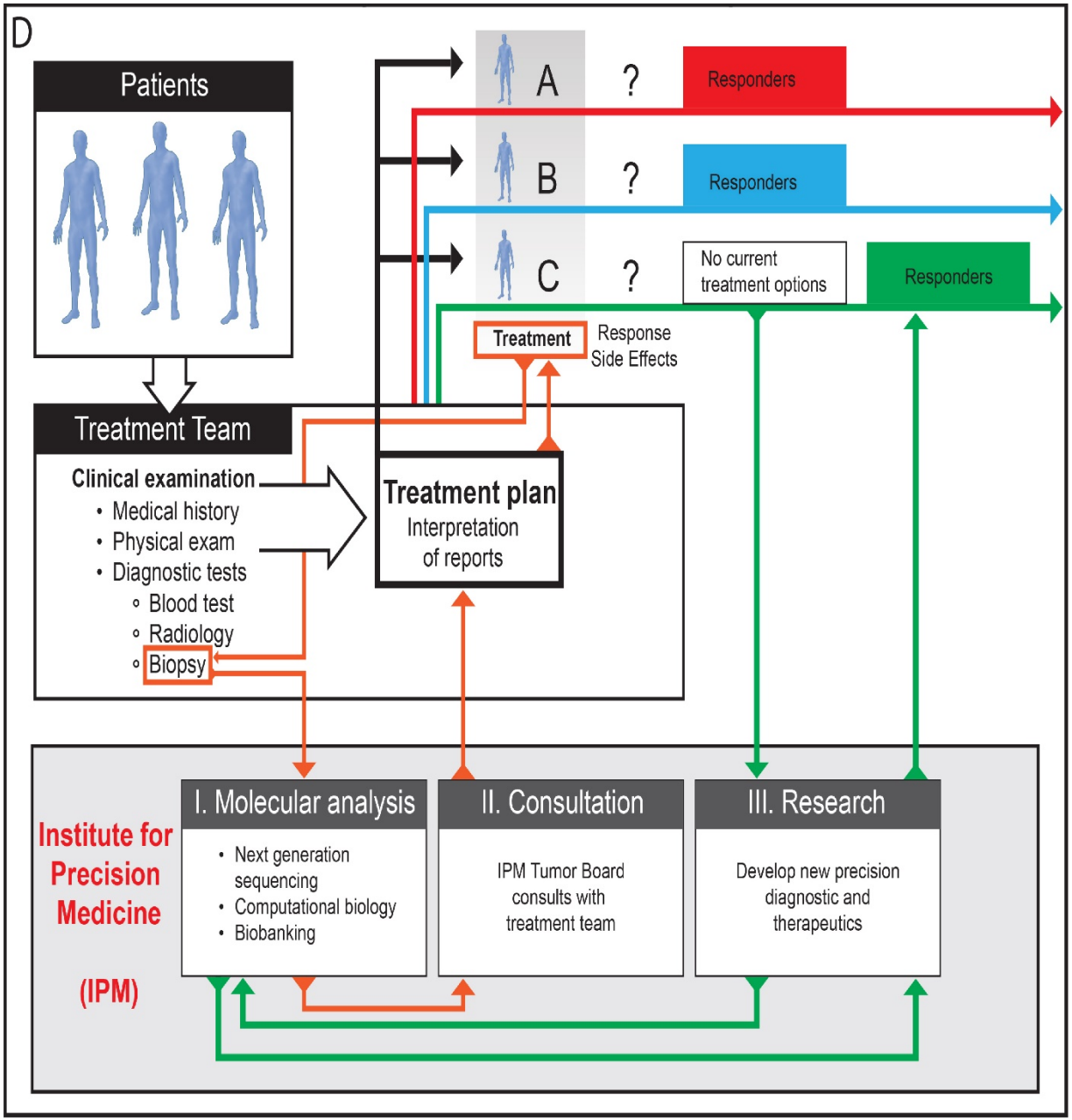


Mutation



Dramatic Response

Klinische Versuche



Hypothese: Präzisionsmedizin kann hilfen, um klinische Studien zu verbessern

Beltran/Rubin JAMA Oncology PMID:26181256

Weill Cornell Medicine PM Experience: Precision Cancer Care in Real Time

Research

Original Investigation

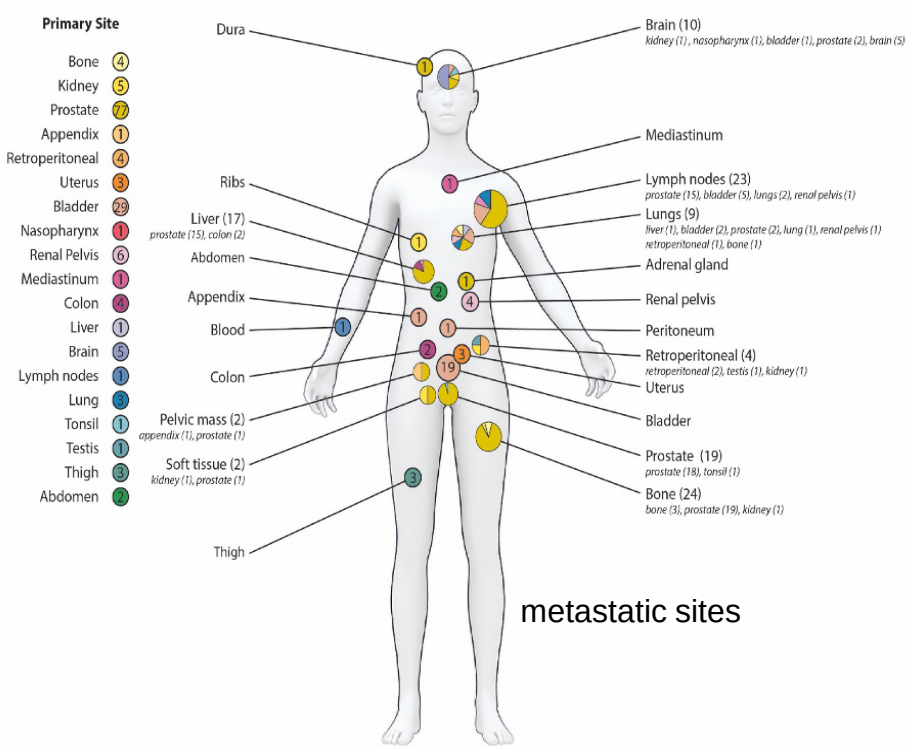
Whole-Exome Sequencing of Metastatic Cancer and Biomarkers of Treatment Response

Himisha Beltran, MD; Kenneth Eng, MS; Juan Miguel Mosquera, MD; Alexandros Sigaras, MS; Alessandro Romanel, PhD; Hanna Rennert, MD; Myriam Kossai, MD; Chantal Pauli, MD; Bishoy Faltas, MD; Jacqueline Fontugne, MD; Kyung Park, MD; Jason Banfelder, MCh.E; Davide Prandi, PhD; Neel Madhukar, BS; Tuo Zhang, PhD; Jessica Padilla, MA; Noah Greco, MBA; Terra J. McNary, BA; Erick Herrscher, BA; David Wilkes, PhD; Theresa Y. MacDonald, BS; Hui Xue, PhD; Vladimir Vacic, PhD; Anne-Katrin Emde, PhD; Dayna Oschwald, PhD; Adrian Y. Tan, MD; Zhengming Chen, PhD, MPH; Colin Collins, PhD; Martin E. Gleave, MD; Yuzhuo Wang, PhD; Dimple Chakravarty, PhD; Marc Schiffman, MD; Robert Kim, BS; Fabien Campagne, PhD; Brian D. Robinson, MD; David M. Nanus, MD; Scott T. Tagawa, MD; Jenny Z. Xiang, MD; Agata Smogorzewska, MD, PhD; Francesca Demichelis, PhD; David S. Rickman, PhD; Andrea Sboner, PhD; Olivier Elemento, PhD; Mark A. Rubin, MD

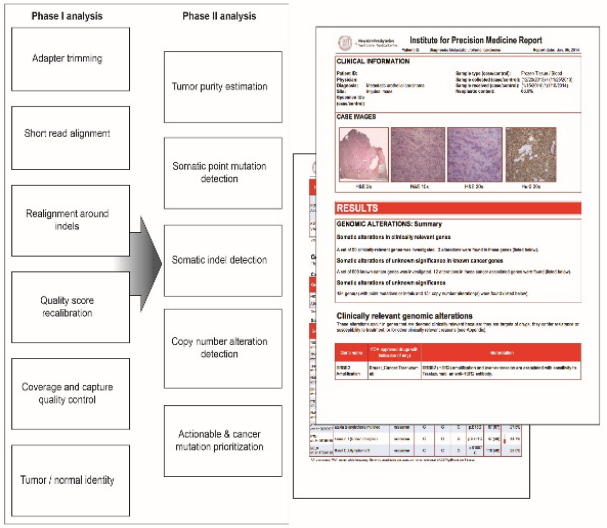
Beltran et al., JAMA Oncology May 28 2015
Rennert et al., npj Genomic Medicine 2016

Seit Oktober 2015 WES Testing bei WCM

EXaCT-1 Genom-Tests für fortgeschrittenen KrebsÜber 1000 getestete Patienten



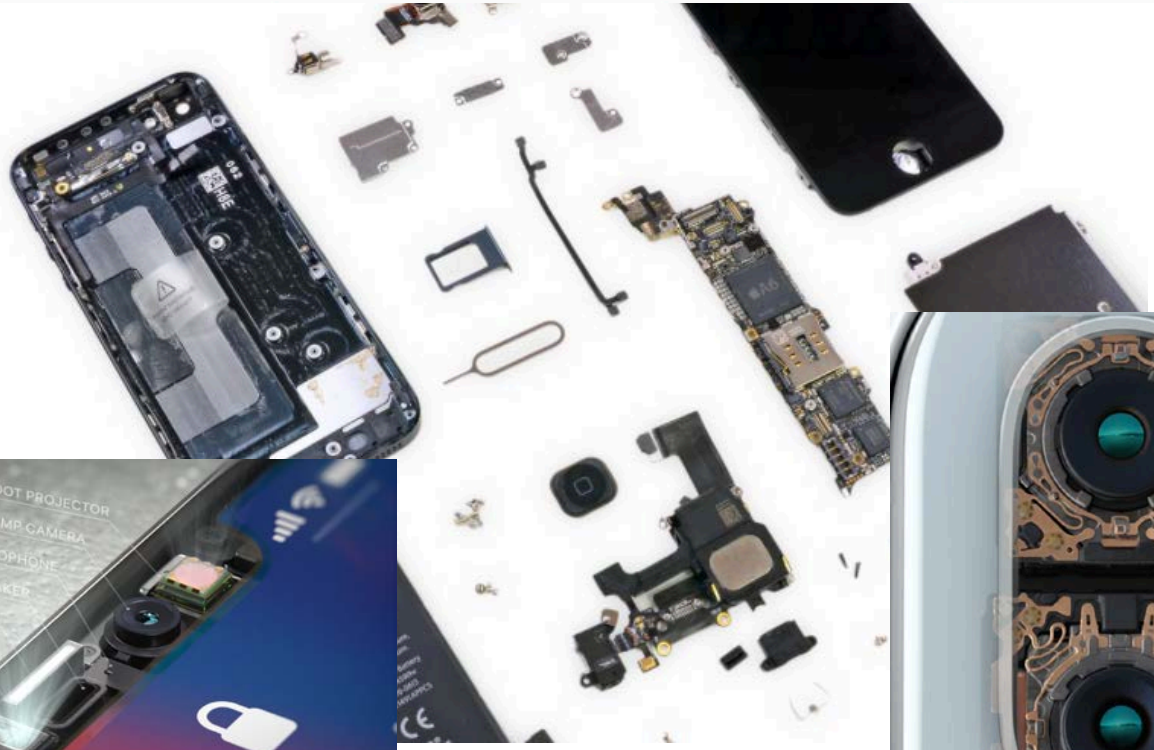
metastatic sites



WES+Analysis pipeline → **patient reports**

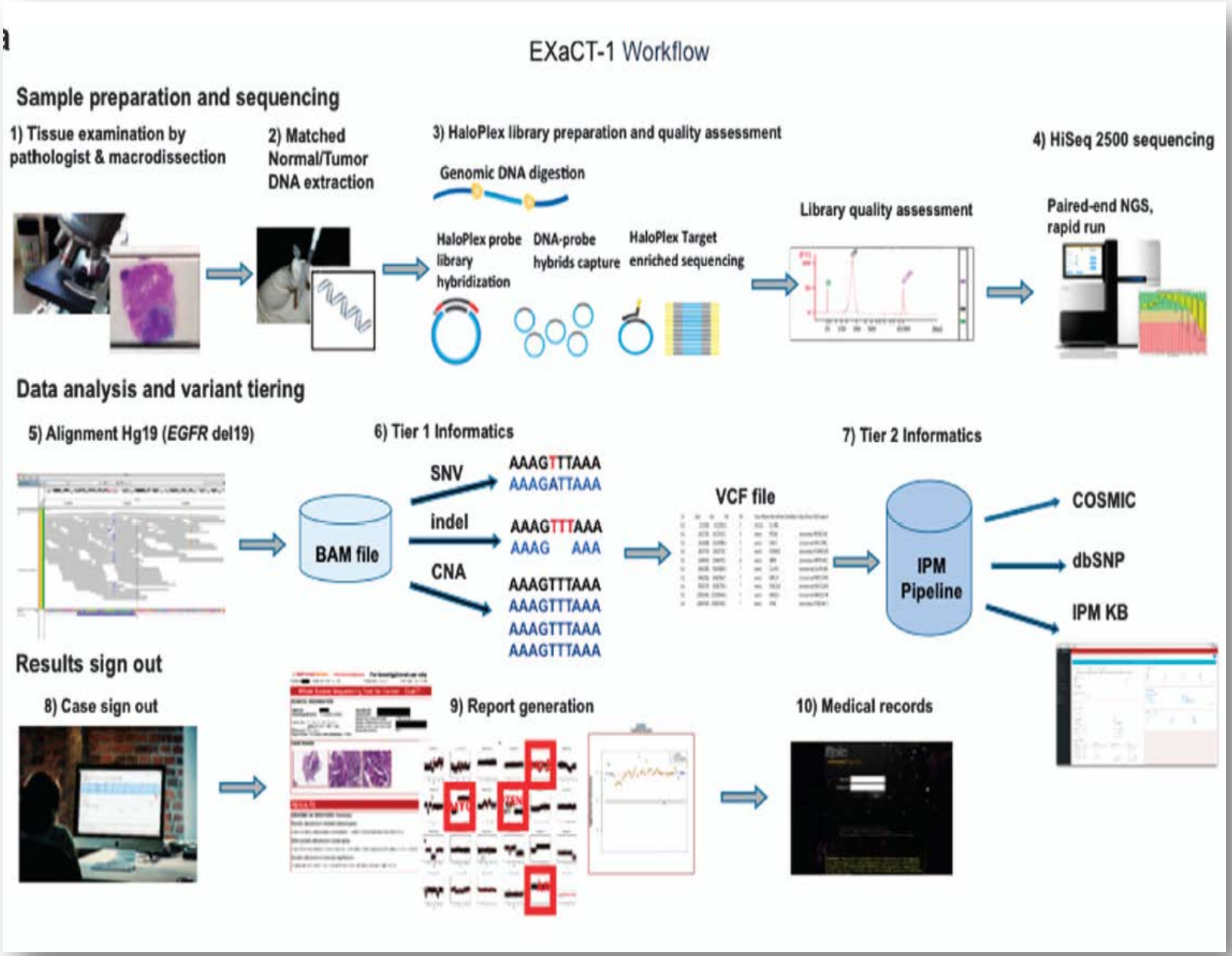
New York State CLEP Approved *Beltran et al., JAMA Oncol.* 2015;1(4):466-474


9:41
Mail
Tuesday
12
Calendar
Photos
Camera
Maps
Clock
Weather
News
Home
Notes
Stocks
Reminders
TV
App Store
iTunes Store
iBooks
Health
Wallet
Settings




DOT PROJECTOR
7MP CAMERA
MICROPHONE
SPEAKER
AMBIENT LIGHT SENSOR
FLOOD ILLUMINATOR
PROXIMITY SENSOR
INFRARED CAMERA


12MP ƒ/1.8 APERTURE WIDE LENS
DUAL OPTICAL IMAGE STABILIZATION
QUAD-LED TRUE TONE FLASH
DEEPER PIXELS
NEW COLOR FILTER
LARGER AND FASTER SENSOR
12MP ƒ/2.4 APERTURE TELEPHOTO LENS



NPJ Genomic Medicine July 20, 2016

Integrierter Bericht mit detaillierter Interpretation

NewYork-Presbyterian
Weill Cornell Medical Center

Institute for Precision Medicine Report - Preliminary

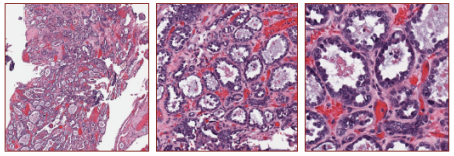
Patient ID: PM266 **Diagnosis:** Clear cell carcinoma **Report date:** Dec. 05, 2014

CLINICAL INFORMATION

Patient ID: PM266
Physician: Himisha Beltran M.D.
Diagnosis: Clear cell carcinoma
Site: Pelvic mass
Specimen IDs (case/control) PM266_ZA2_1_Case_HALO, PM266_ZC2_1_Ctrl_HALO

Sample type (case/control): FFPE / FFPE
Sample collected (case/control): (3/18/2014) / (3/18/2014)
Sample received (case/control): (11/14/2014) / (11/14/2014)
Neoplastic content: 56.6%

CASE IMAGES



RESULTS

GENOMIC ALTERATIONS: Summary

Somatic alterations in clinically relevant genes

A set of 49 clinically relevant genes was investigated. 2 alterations were found in these genes (listed below).

Somatic alterations of unknown significance in known cancer genes

A set of 509 known cancer genes was investigated. 8 alterations in these cancer associated genes were found (listed below).

Somatic alterations of unknown significance

13 gene(s) with point mutations or indels and 41 copy number alteration(s) were found (listed below).

Clinically relevant genomic alterations

These alterations occur in genes that are deemed clinically relevant because: they are targets of drugs, they confer resistance or susceptibility to treatment, or for other clinically relevant reasons (see Appendix).

NewYork-Presbyterian
Weill Cornell Medical Center

Institute for Precision Medicine Report - Preliminary

Patient ID: PM266 **Diagnosis:** Clear cell carcinoma **Report date:** Dec. 05, 2014

Gene name	FDA approved drugs with indication (if any)	Interpretation
FGFR3 focal amplification	none	FGFR3 amplification may be associated with response to the multitargeted tyrosine kinase inhibitor pazopanib (Liao et al, 2013, Cancer Res).

VAF: variant allele frequency

Notes

The status of alterations in gene(s) **KRAS** is indeterminate because the coverage was below the optimal levels of this method (<10 reads). Hence, analysis of the alteration(s) with an independent methodology will be performed.

Genomic alterations of unknown significance in cancer genes

These alterations occur in genes that are cancer associated, but their impact on the disease is unknown (see Appendix).

Copy number alterations

Gene name	Description	Classification of alteration	Altered region
FH	fumarate hydratase	LARGE SCALE AMPLIFICATION	chr1:223,533,597-249,212,519
H3F3A	H3 histone, family 3A	LARGE SCALE AMPLIFICATION	chr1:223,533,597-249,212,519
BCL7A	B-cell CLL/lymphoma 7A	FOCAL AMPLIFICATION	chr12:122,468,644-123,419,896
STAT3	signal transducer and activator of transcription 3 (acute-phase response factor)	FOCAL AMPLIFICATION	chr17:40,039,428-40,673,093
YWHAE	tyrosine 3-monooxygenase/tryptophan 5-monooxygenase activation protein, epsilon polypeptide (14-3-3 epsilon)	FOCAL AMPLIFICATION	chr17:649,687-1,968,405
AKT2	v-akt murine thymoma viral oncogene homolog 2	FOCAL AMPLIFICATION	chr19:39,759,400-40,947,690
WHSC1	Wolf-Hirschhorn syndrome candidate 1(MMSET)	FOCAL AMPLIFICATION	chr4:1,316,228-2,160,908

Genomic coordinates are based on human reference GRC37/hg19. Large scale alterations involve at least 50 genes.

Somatic mutations and indels

Gene name	Gene description	Classification	Reference Allele	Tumor Allele 1	Tumor Allele 2	AA change	Tumor (Normal) read depth	Tumor VAF
ARID1A chr1:27094361	AT rich interactive domain 1A (SWI-like)	nonsense	G	G	A	p.W1024 *	53 (55)	41.5%

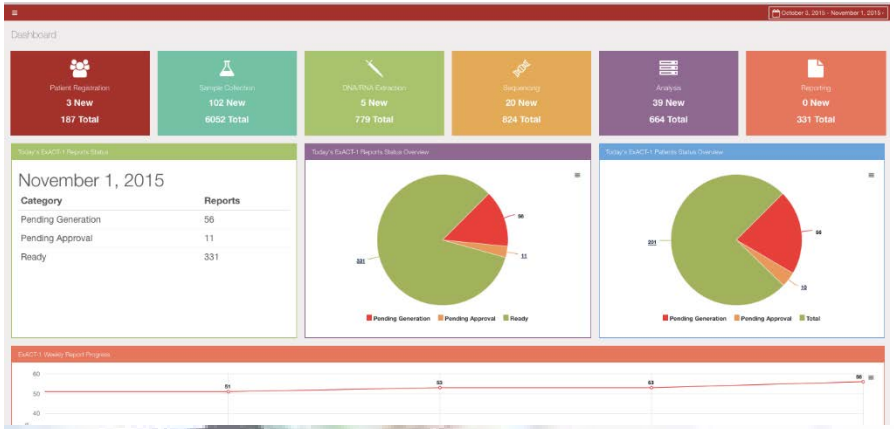
AA: amino-acid; VAF: variant allele frequency; Genomic coordinates are based on human reference GRC37/hg19 and are 1-based.

Genomic alterations of unknown significance

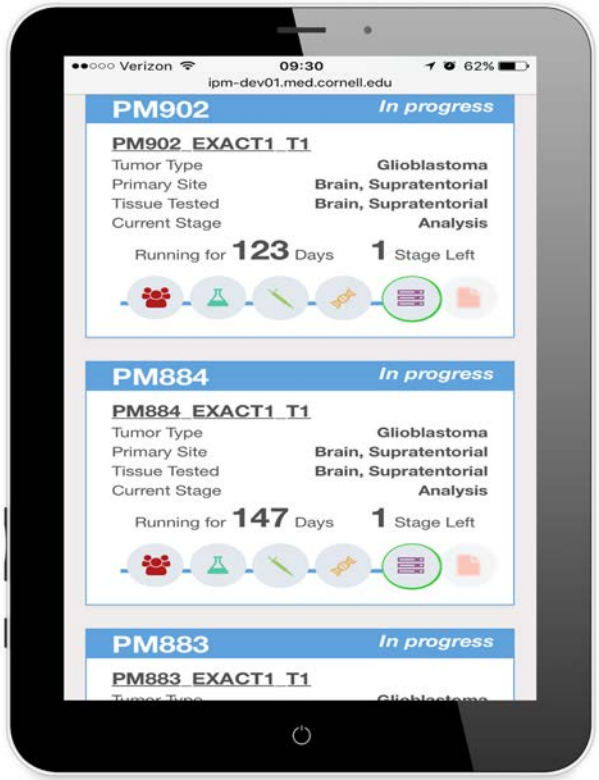
These alterations are not known to have any effect on the disease, but are here reported in the event that in the future progress in scientific knowledge could determine their role (see Appendix).

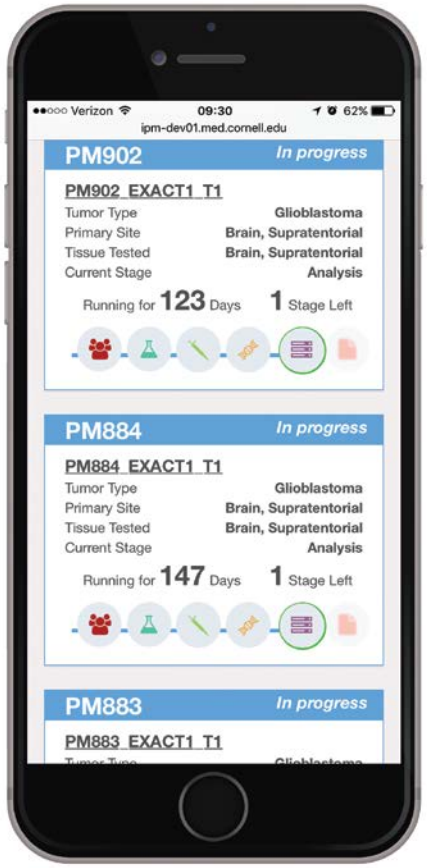
Alle Patienten- und Genomdaten wurden gespeichert. Nicht nur Teildaten.

Patient, doctor, admin specific dashboards



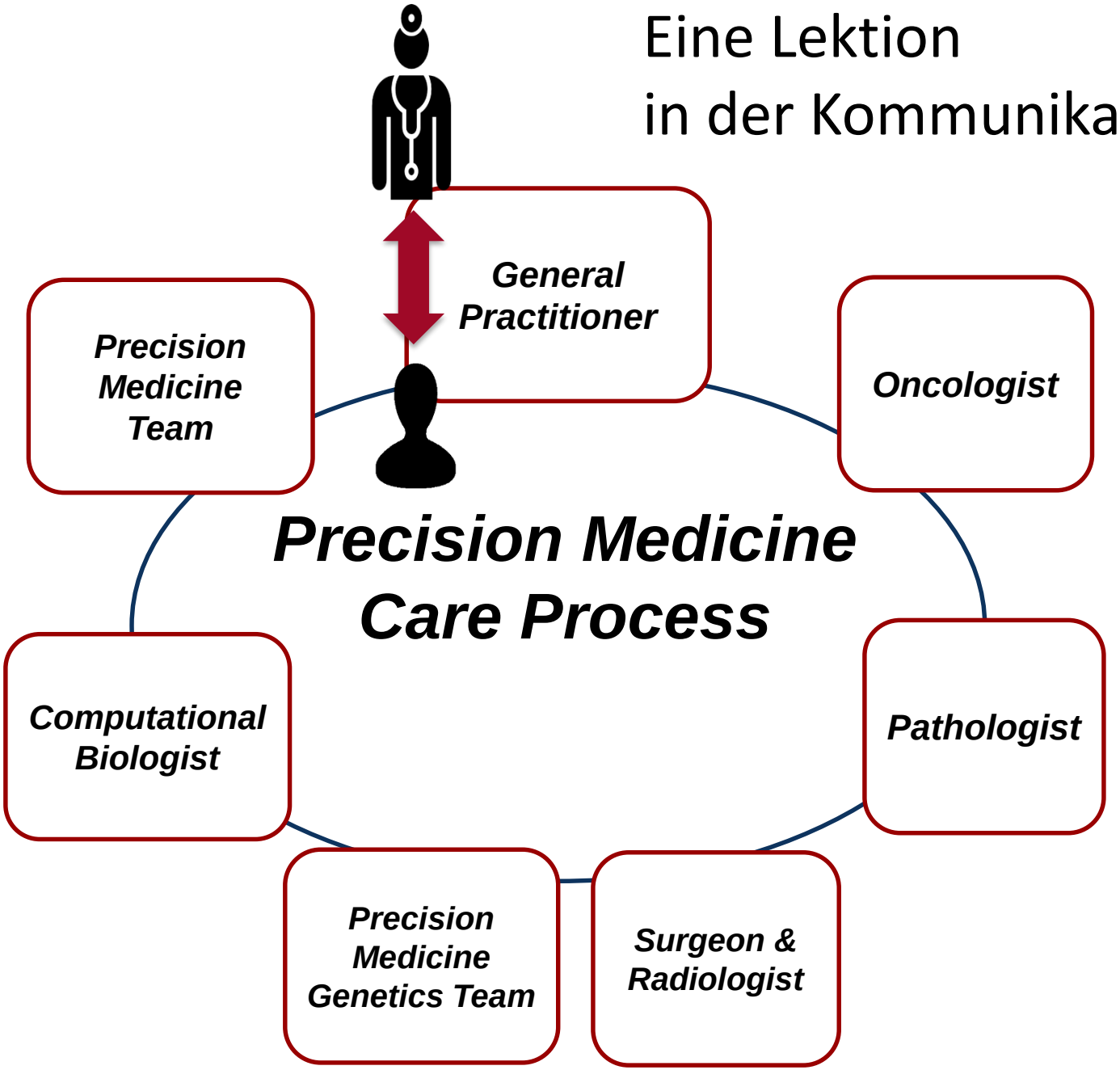
Tracker – Mobile





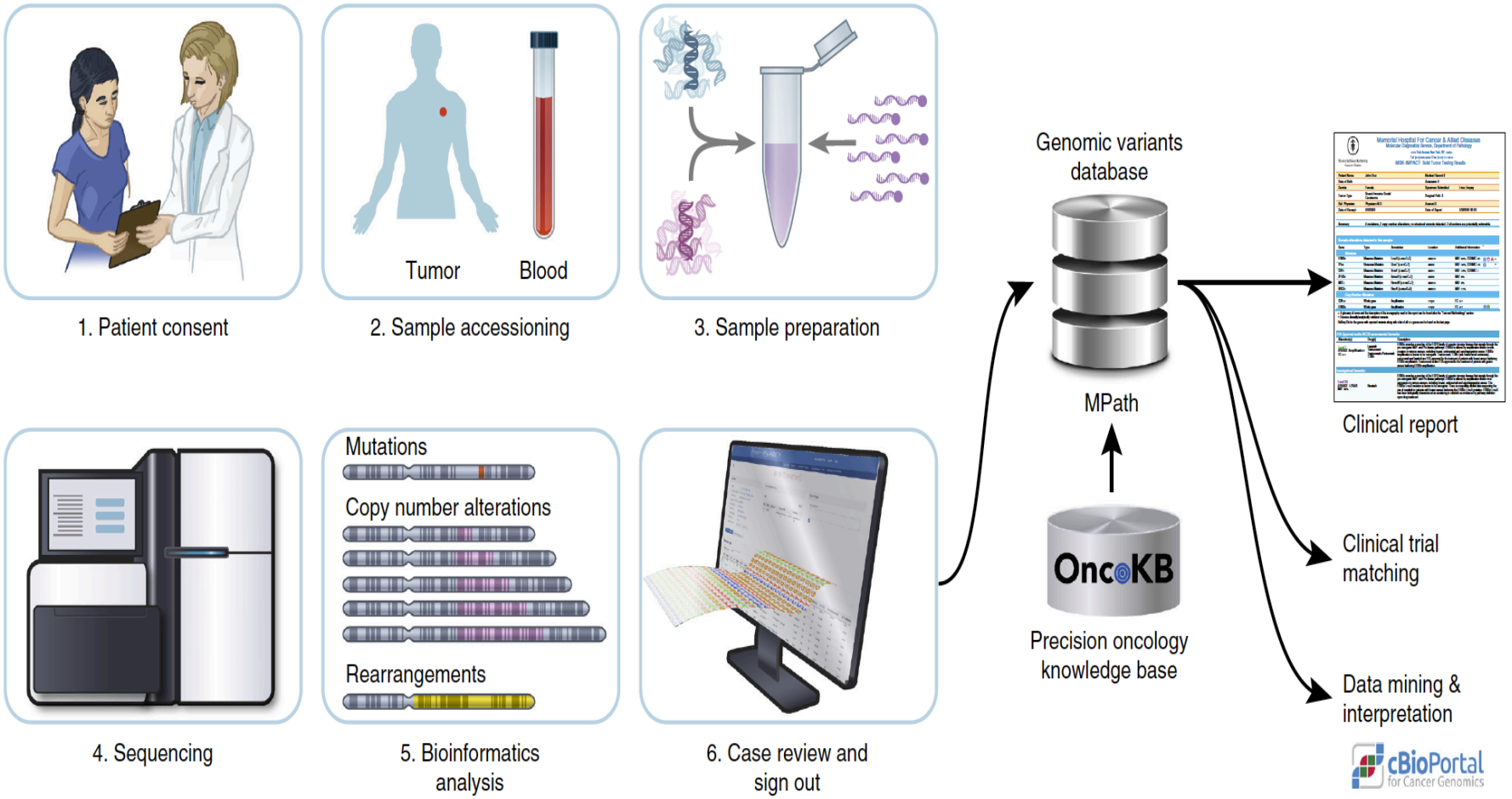
Weill Cornell Medicine

Eine Lektion in der Kommunikation



Präzisionsmedizin-Tumorboard

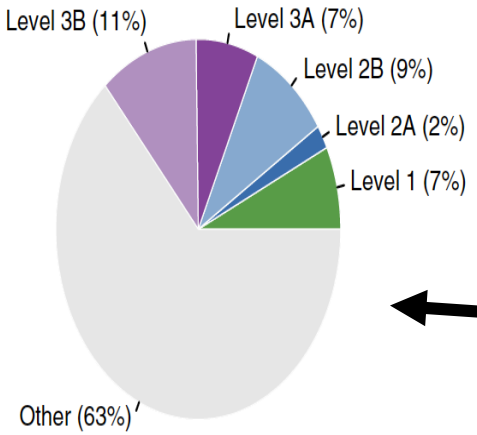
Wie sieht die genomische Analyse von 10.000 Patienten aus?



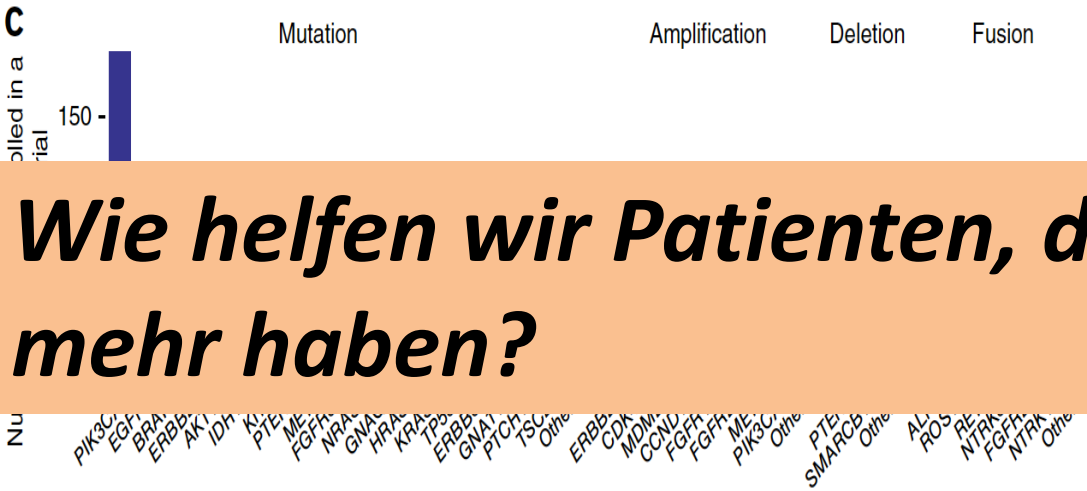
Mike Berger and MSKCC Team, Nature Med 2017

Wie viele Patienten können auf Basis **der Daten** eine neue Behandlung erhalten?

Level 1	FDA-recognized biomarker for an FDA-approved drug in the same indication
Level 2A	Standard of care biomarker for an FDA-approved drug in the same indication
Level 2B	Standard of care biomarker for an FDA-approved drug in another indication
Level 3A	Compelling clinical evidence supporting the biomarker as being predictive of drug response in the same indication
Level 3B	Compelling clinical evidence supporting the biomarker as being predictive of drug response in another indication



Nur 7% Level 1



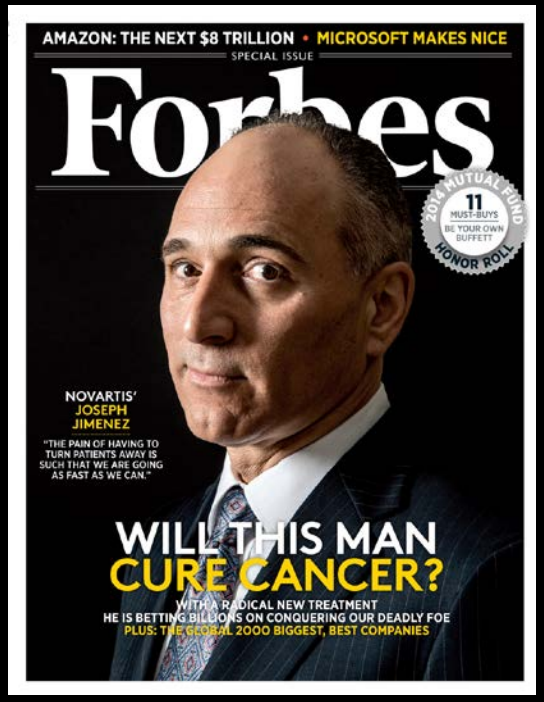
Wie helfen wir Patienten, die keine Optionen mehr haben?

Mike Berger and MSKCC Team, Nature Med 2017


TIME
What if your immune system could be taught to kill cancer?
Inside the brutally selective, hugely expensive, lifesaving trials of immunotherapy.
By Alice Park


Science
Breakthrough of the Year
Cancer Immunotherapy
T cells on the attack


2015 TOP CANCER DOCTORS
Newsweek
SPECIAL HEALTH ISSUE
EXPLORING THE VIKING GENOME
SUPER RESPONDERS TO THE RESCUE
CURING CANCER
MAKING MEDICAL RADIO WAVES
THE TRAGIC LACK OF MEDS FOR KIDS
THE DRUG IS TOO DAMN EXPENSIVE!


AMAZON: THE NEXT $8 TRILLION • MICROSOFT MAKES NICE
SPECIAL ISSUE
Forbes
2015 MUTUAL FUND HONOR ROLL
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WILL THIS MAN CURE CANCER?
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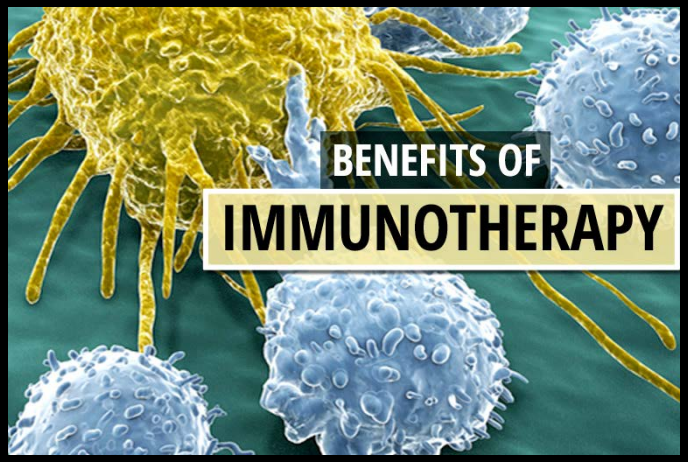
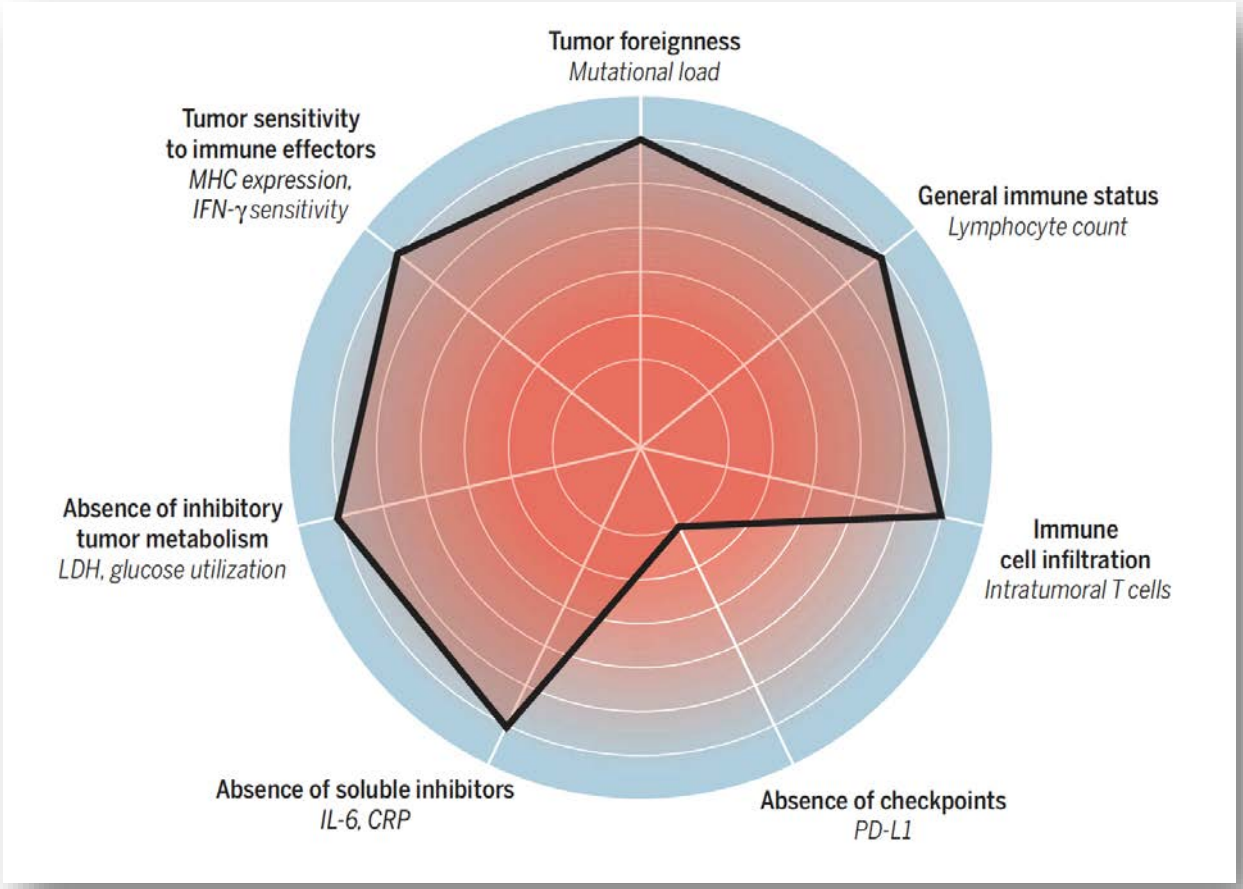
PLUS: THE GLOBAL 2000 BIGGEST, BEST COMPANIES


OUTLOOK Haemophilia
nature
THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE
Antitumour immunity enhanced by inhibiting PD-L1/PD-1 and identifying mutant neo-antigens
IMMUNE-CHECKPOINT BLOCKADE IN CANCER
PEER REVIEW
ACCEPT YOUR OWN PAPER
How some scientists are duping the system
MICROSCOPY
THE CASE FOR AIMING HIGHER
Atomic resolution is there for the taking
ENERGY
'NIGHT-TIME' COOLING BY DAY
New materials enable radiative cooling in sunlight


BENEFITS OF
IMMUNOTHERAPY



CANCER IMMUNOLOGY

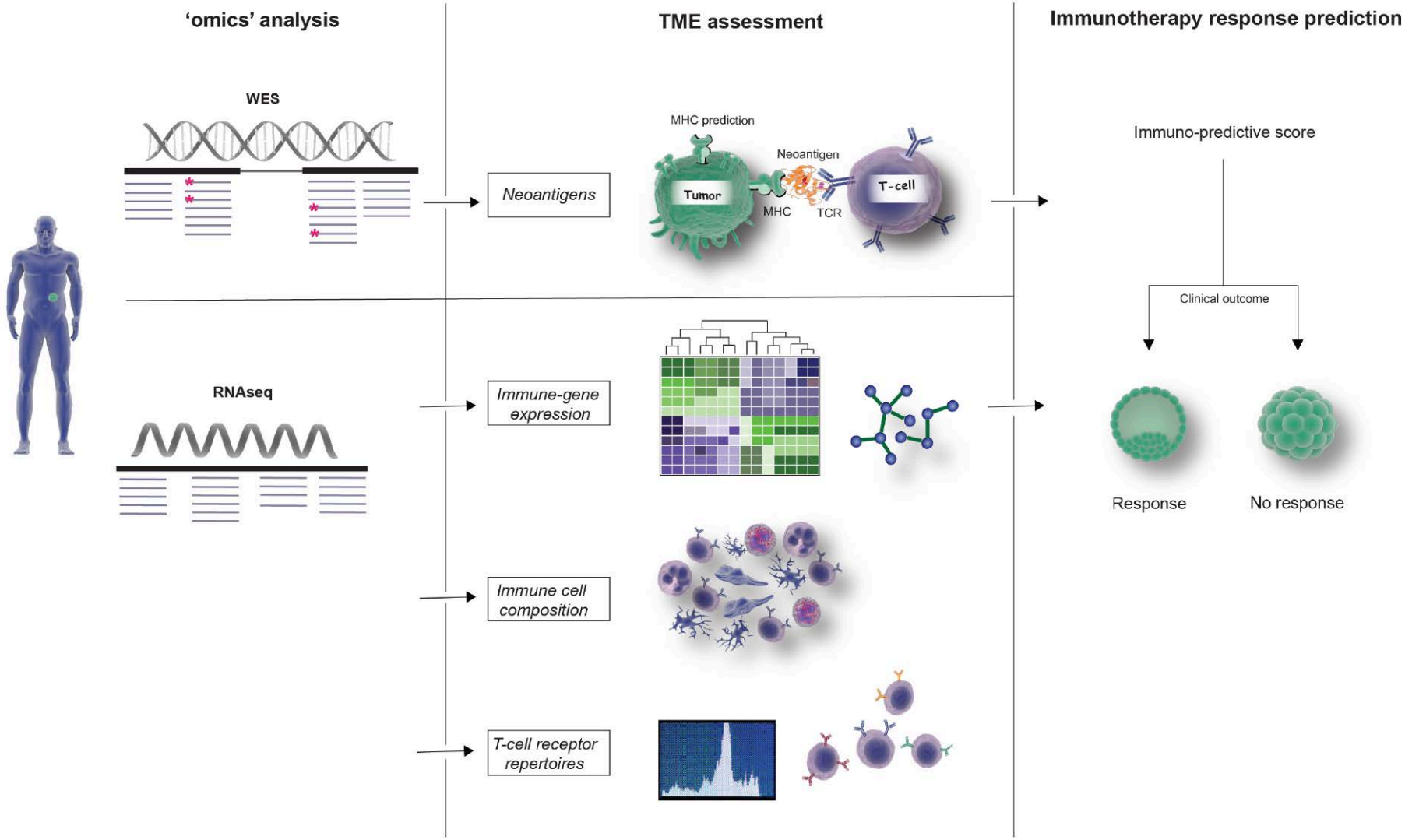
The "cancer immunogram"

Visualizing the state of cancer–immune system interactions may spur personalized therapy

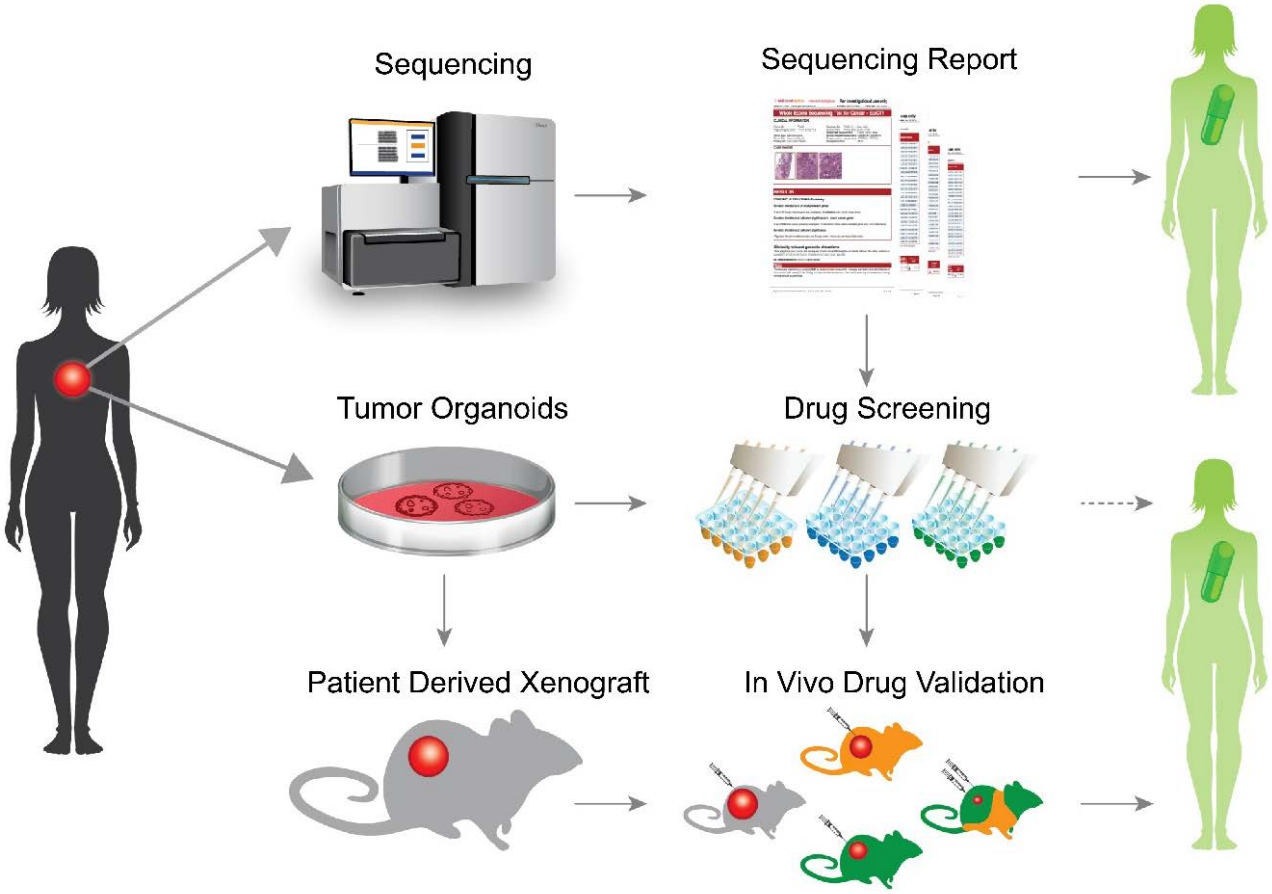
By **Christian U. Blank,[1,2] John B. Haanen,[1,2] Antoni Ribas,[3] Ton N. Schumacher[2]**

Science May 2016

Wir brauchen **viele Daten**, um zu verstehen, welche Patienten von dieser teuren Behandlung profitieren.

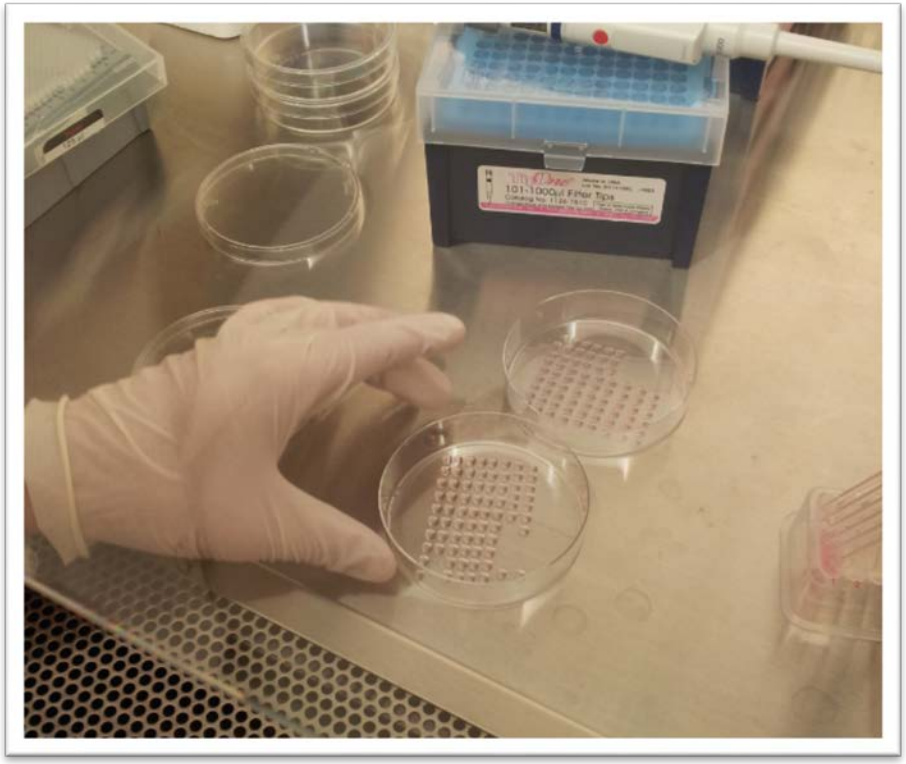


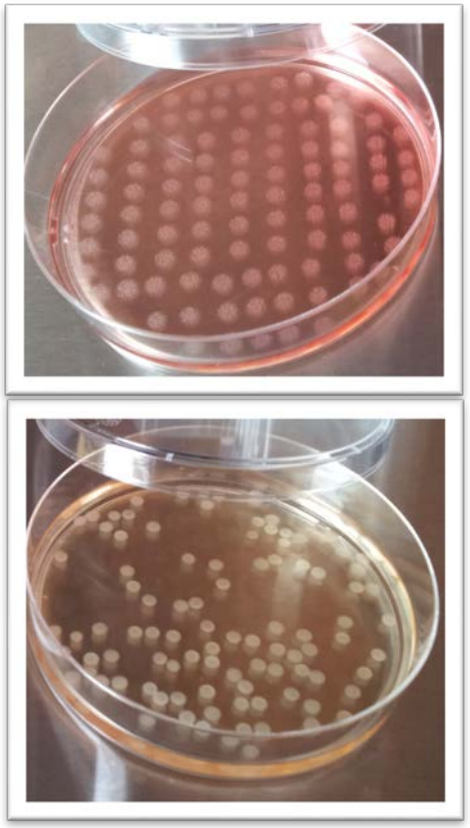
Personalized Cancer Models to Guide Precision Medicine



Pauli, Hopkins et al., Cancer Discovery 2017 PMID 28331002

Organoids in drug testing: In vitro – Mini Sarcoma Production

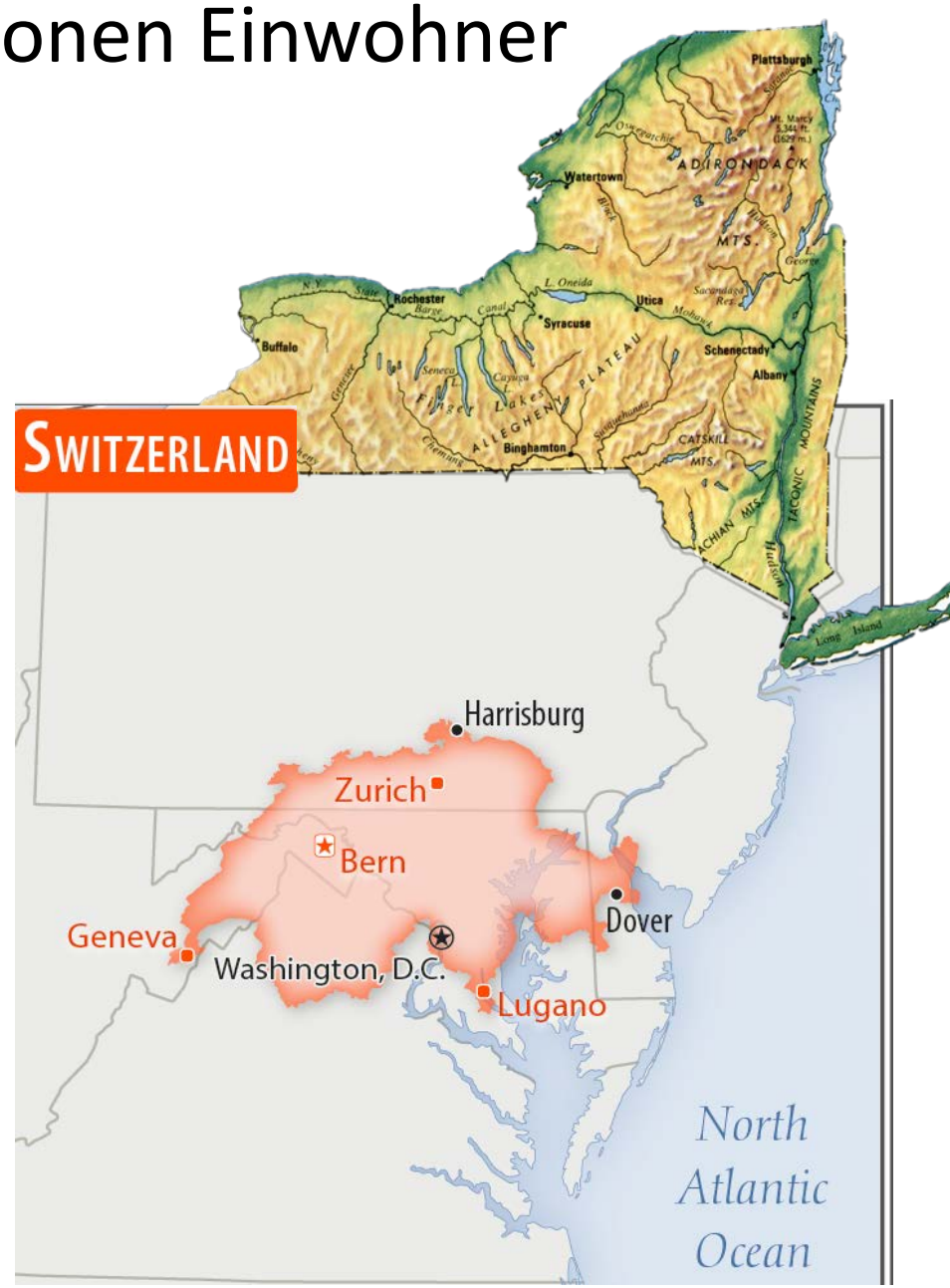




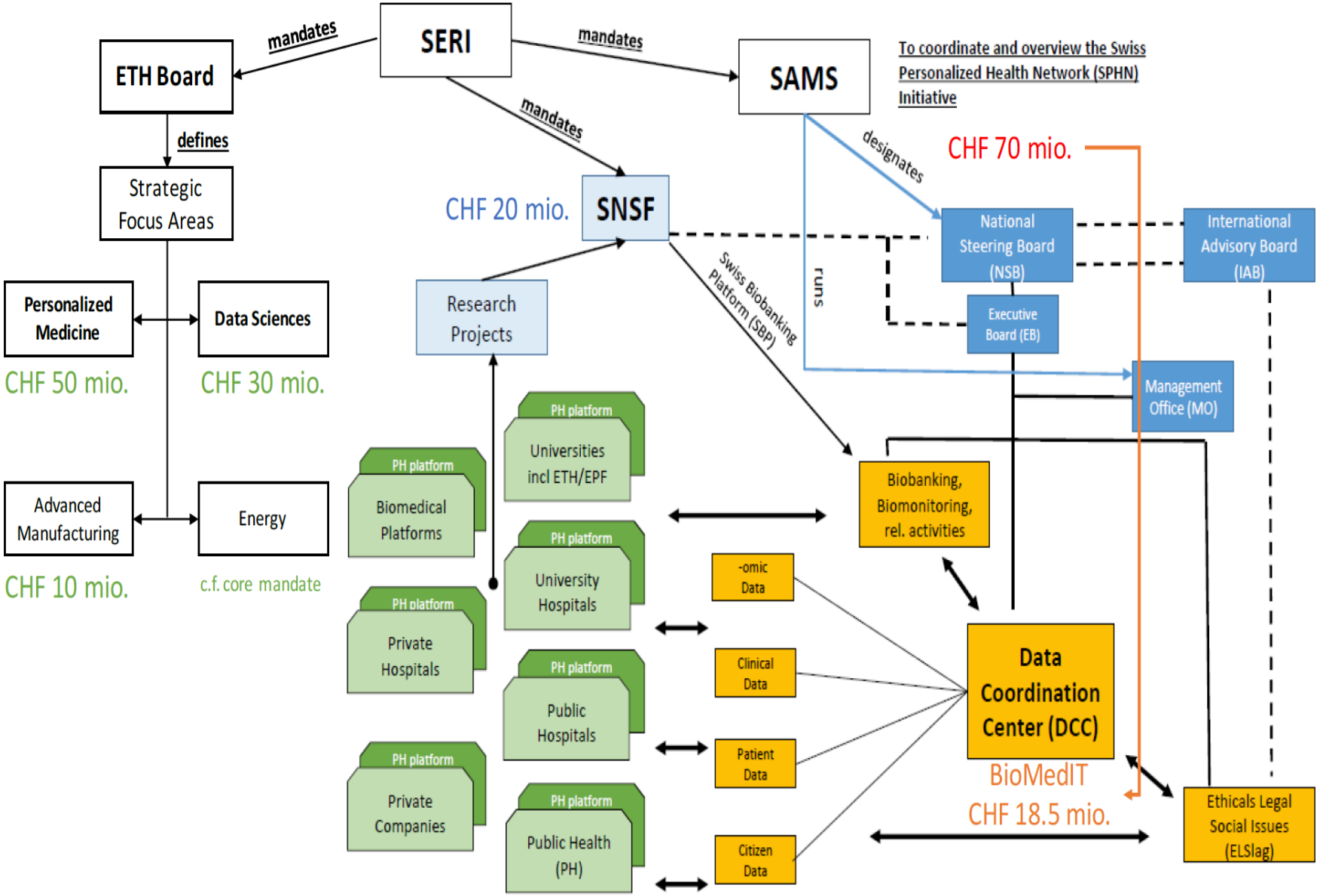
Pauli et al, March 2017

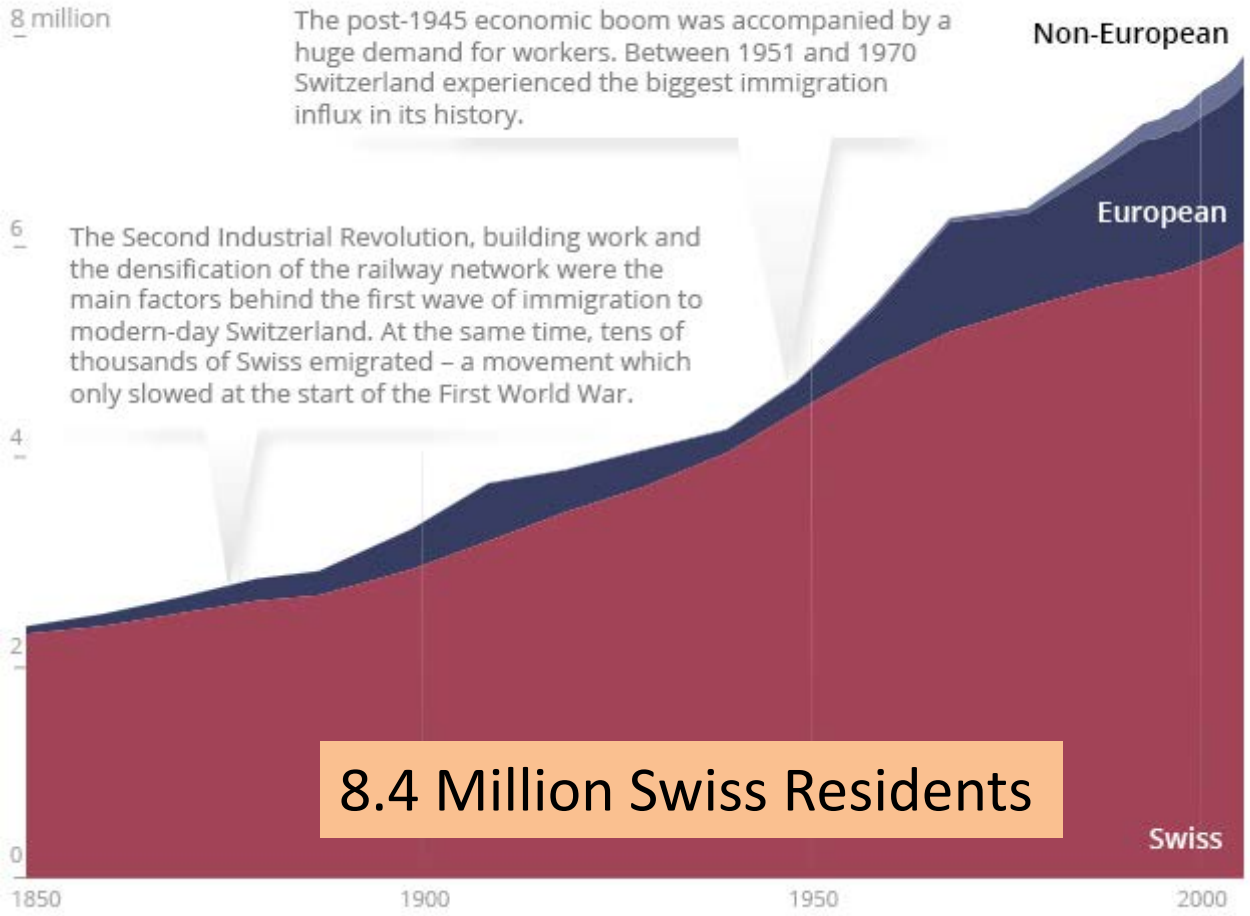

TOBLERONE
© Hallwag Kümmerly+Frey AG, CH-3322 Schönbühl/Bern

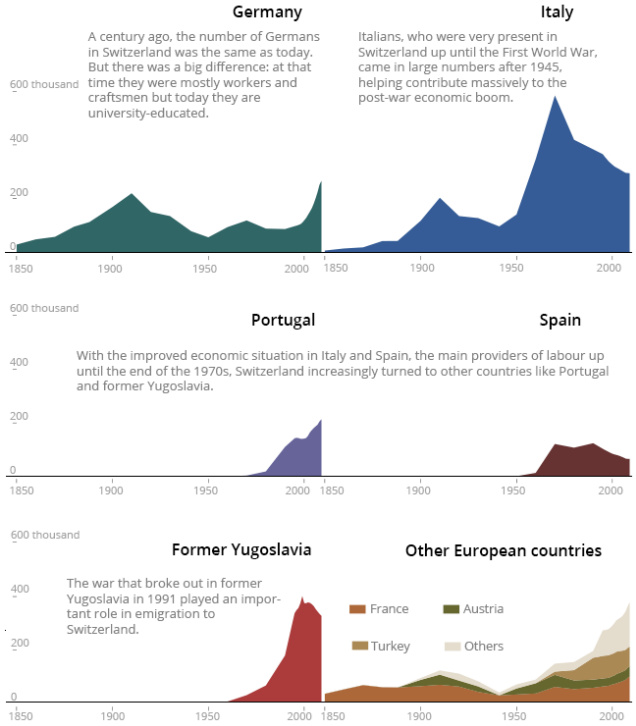
Die Schweiz: Rund 8,5 Millionen Einwohner



Wie wird die Präzisionsmedizin in der Schweiz aussehen?

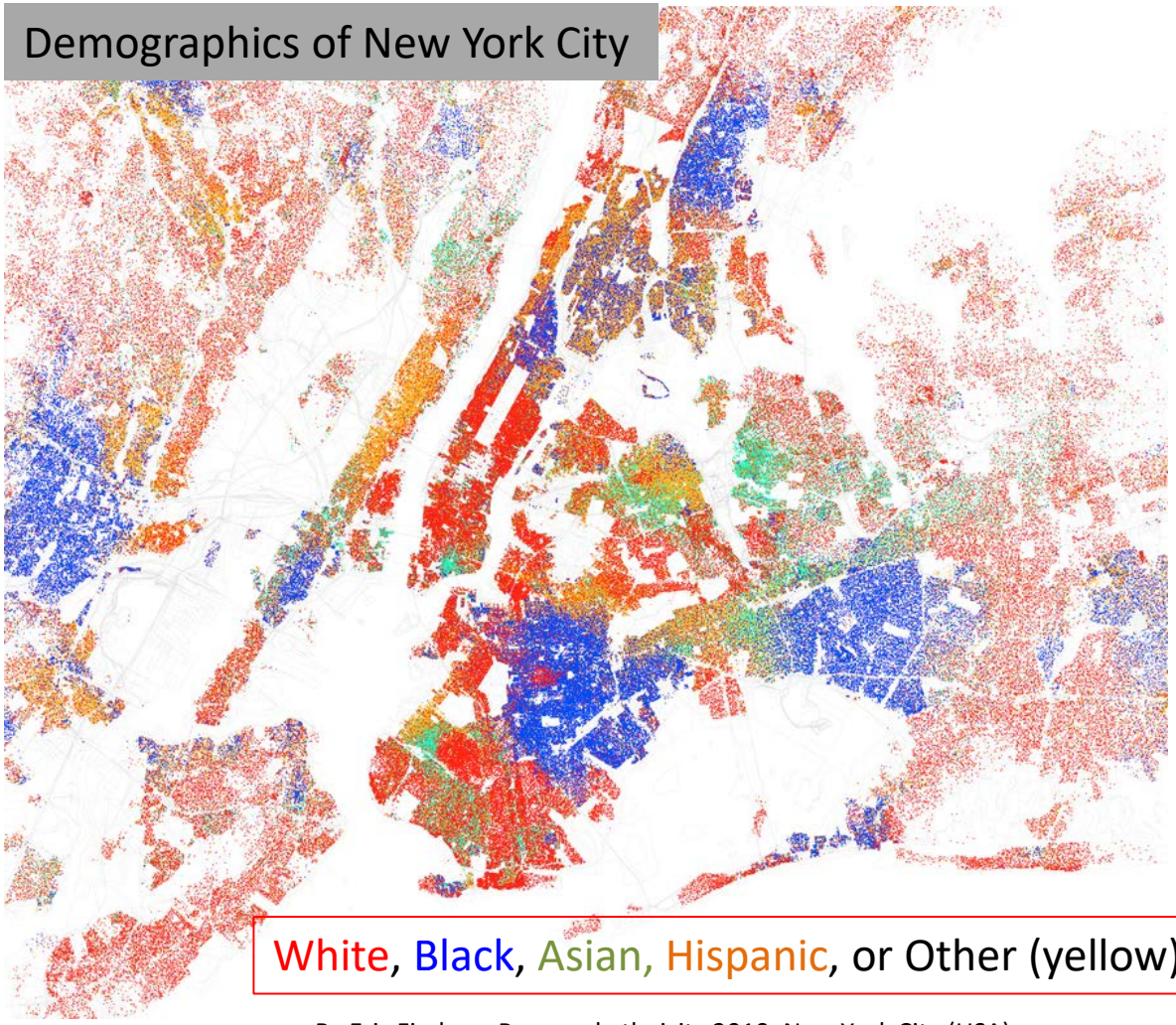






SWI swissinfo.ch

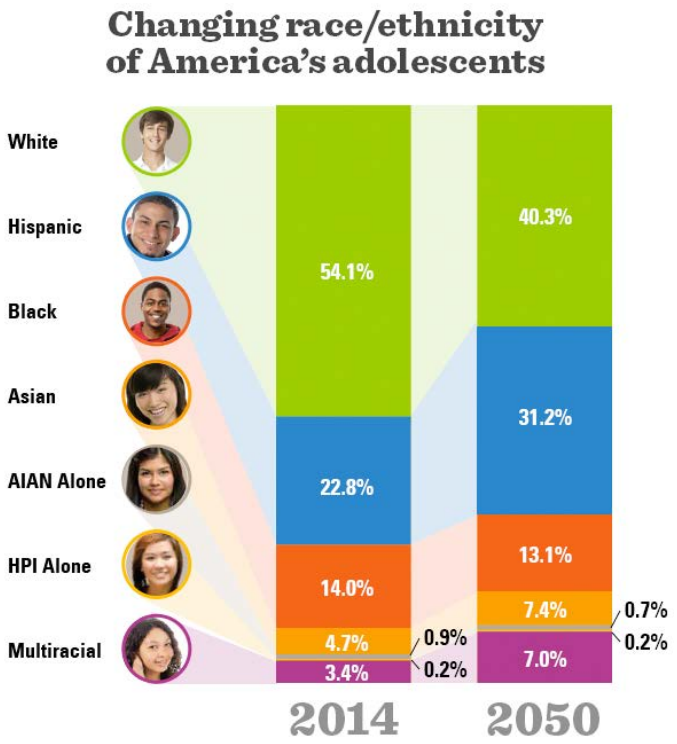
Demographics of New York City



White, Black, Asian, Hispanic, or Other (yellow)

By Eric Fischer - Race and ethnicity 2010: New York City (USA)

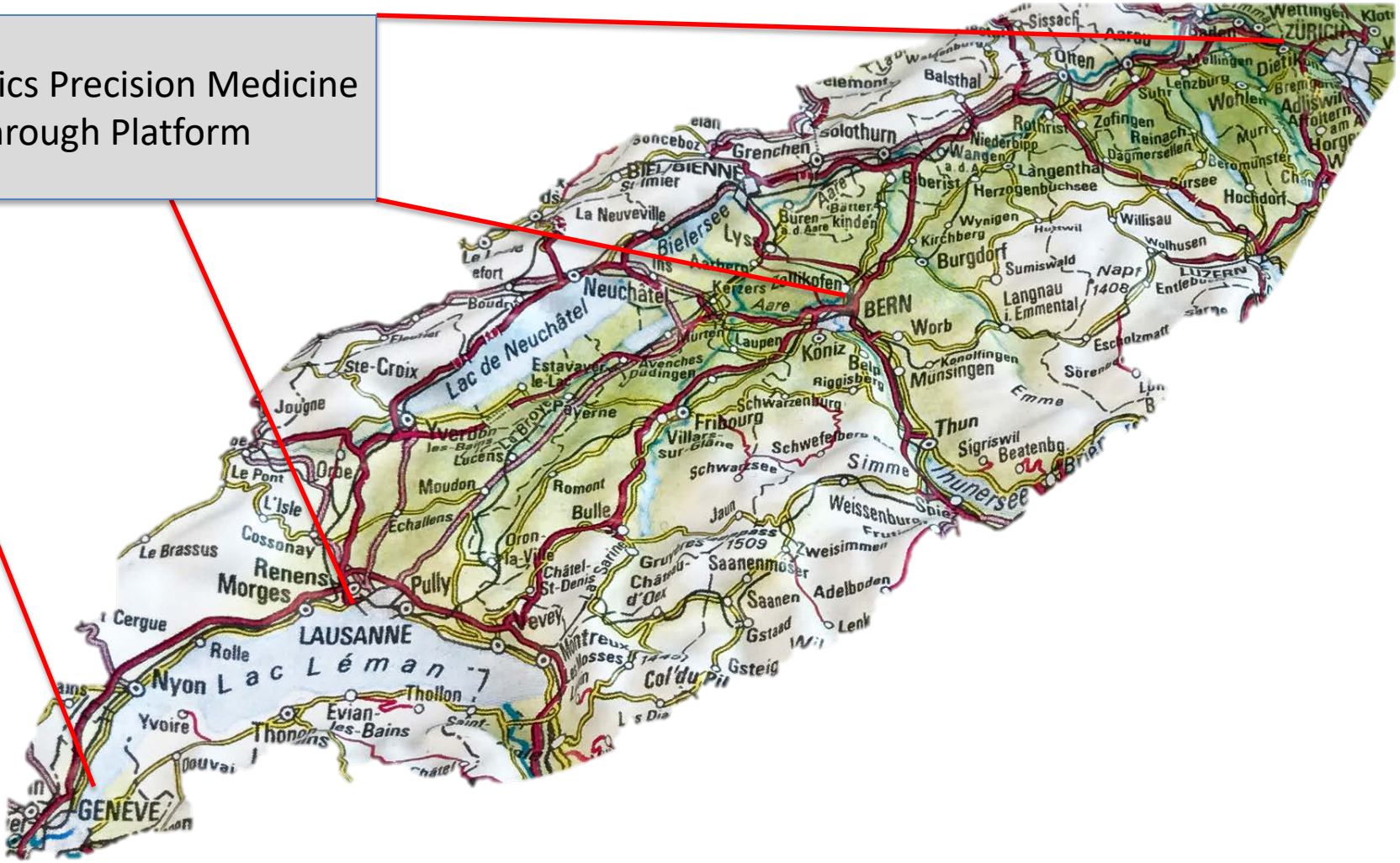
Changing USA Ethnicity



AIAN American Indian and Alaska Native

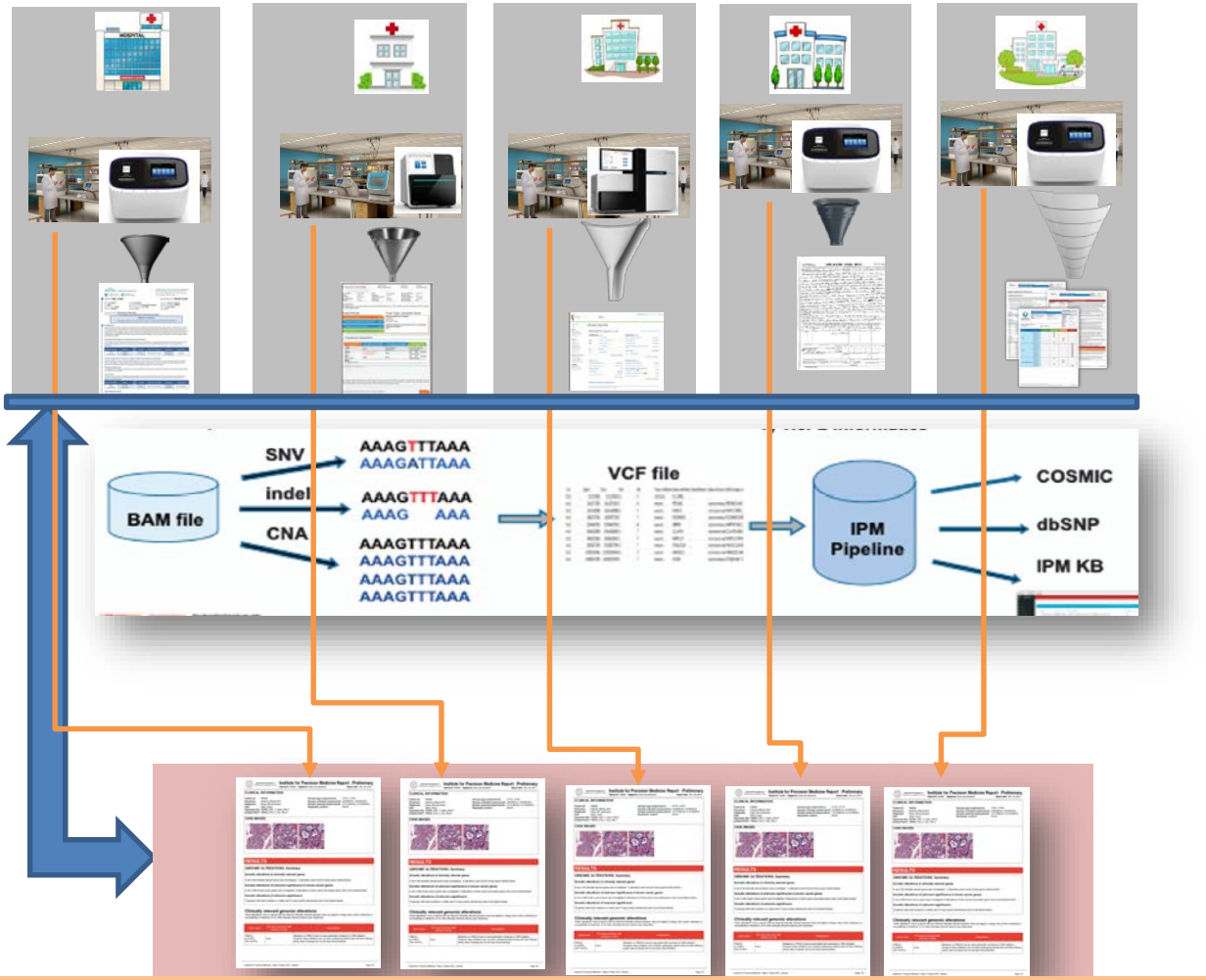
By Mugeek Vidalondon

Genomics Precision Medicine
Breakthrough Platform



z.b.,

Wie sieht **genomische Analyse** heute in der Schweiz aus?



*Wie können wir den Wert der **genomischen Daten** in der Schweiz verbessern?*

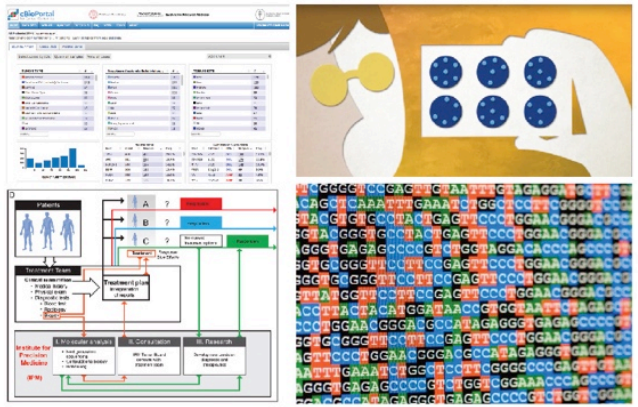
SPHN/PHRT Proposal from Bern, Zurich, Lausanne, and Geneva

UNIVERSITY HOSPITAL UNIFORM REPORTING

WP1. Determine optimal configuration for uniform genomics reporting to enable reliable sharing of clinical and research data.(SIB/Others)

WP2. Harmonize Swiss uniform genomics reporting format(s) for clinical and research interoperability. (Patholink SNF & Onco SPHN)

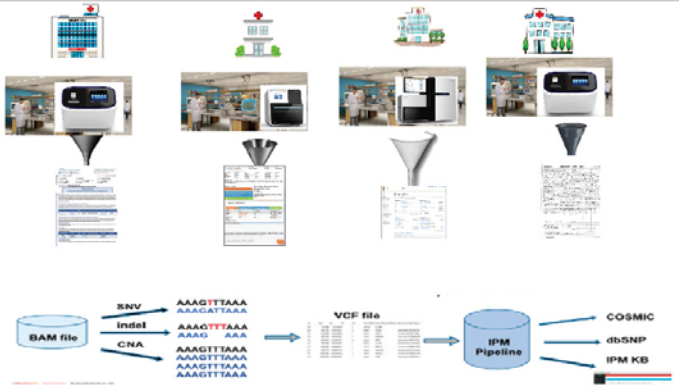
DATA SHARING FOR RESEARCH & CLINICAL



WP3. Establish external SOCIBP sites and improve use/operator features for broader clinical and research connectivity (SIB/SAKK/Intern'l)

Swiss Genomics Today: Many Solutions and Lack of Uniform Reporting

UNIVERSITY HOSPITAL UNIFORM REPORTING



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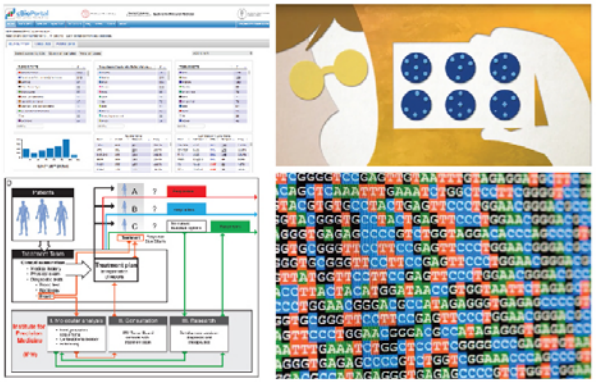


WP3. Establish external SOCIBP sites and improve use/operator features for broader clinical and research connectivity (SIB/SAKK/Intern'l)

Swiss Molecular Pathology and Tumor Immunology Breakthrough Platform (SOCIBP)

SPHN Driver Project

Universität Bern / Inselspital

Mark A Rubin (Main Applicant)
Tobias Grob (WP2)
Rémy Bruggmann (WP1,3)

Universitätspital Zürich

Holger Moch (Co-Applicant, WP2)

PHRT Project

ETH-Zürich

Gunnar Rätsch (Co-Applicant, WP3,5,6)

EPFL-Ludwig Institute

George Coukos (Co-Applicant, WP4,6)

Co-Applicants (WP2)

CHUV Lausanne	Laurence de Leval
Hôpitaux Universitaires Genève	Thomas McKee

Proposed

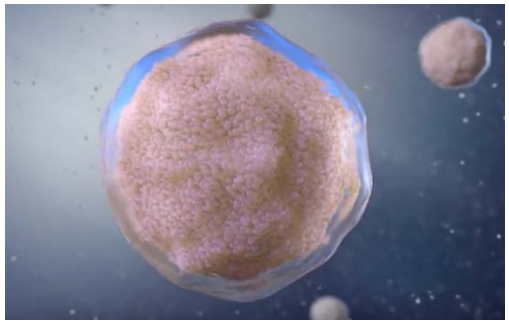
Other Interactions

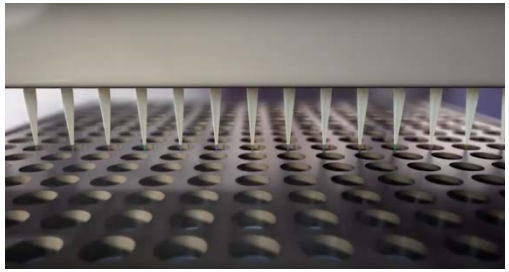
Swiss Institute of Bioinformatics
PATHOLINK (SNF)
Englander Institute of PM (Cornell)
Other SPHN/PHRT Projects (see table)

Was sind die Kosten?

F (PM)=Social and economic PM Model

Danke für Ihre Aufmerksamkeit





mark.rubin@dbmr.unibe.ch