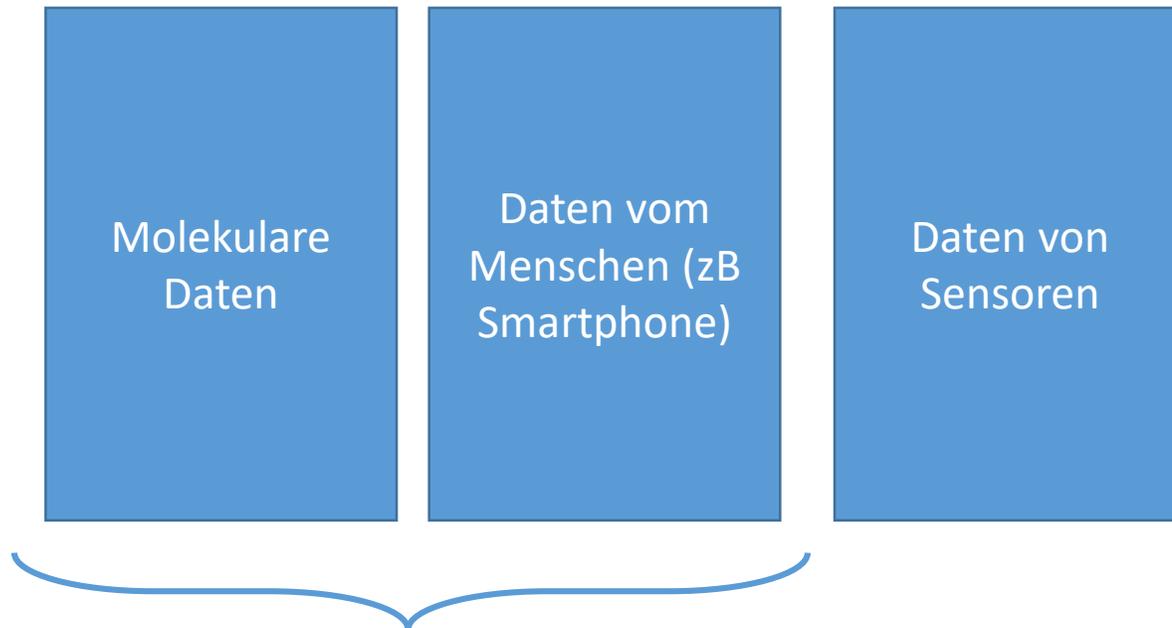


# MultiOmics Analyses of complex biomedical data for pharmaceutical applications

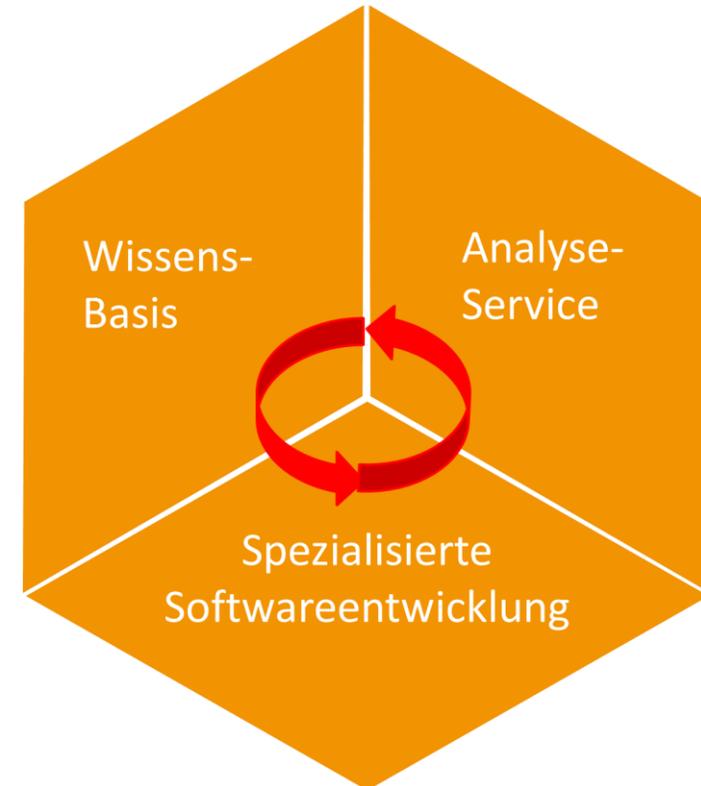
Josef Scheiber, PhD

Managing Director BioVariance GmbH

# Komplexe Datenanalysen für bessere individualisierte Behandlungen und die Wirkstoffforschung



Fokus heute

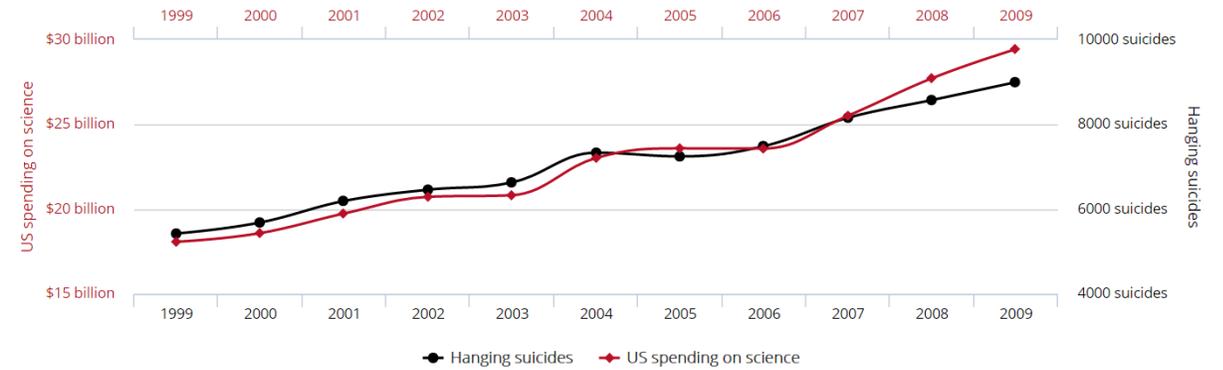


# Important: Avoid random correlations



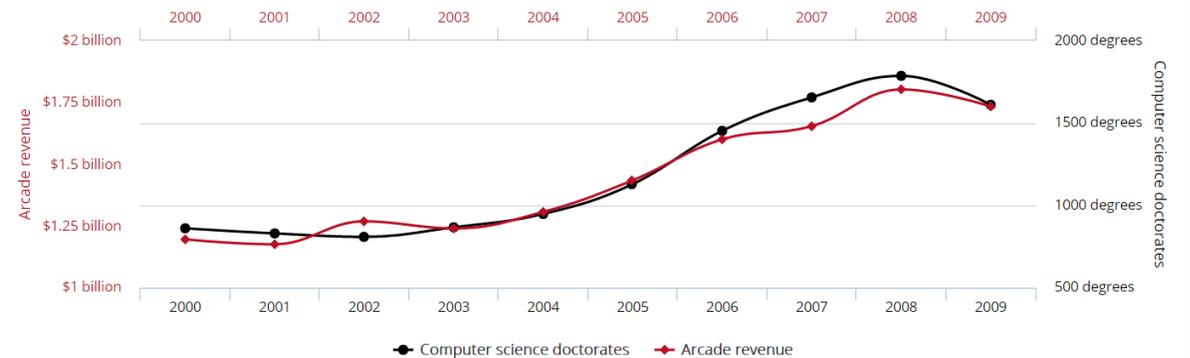
US spending on science, space, and technology  
correlates with  
Suicides by hanging, strangulation and suffocation

Correlation: 99.79% (r=0.99789126)



Total revenue generated by arcades  
correlates with  
Computer science doctorates awarded in the US

Correlation: 98.51% (r=0.985065)



# The key issue – The data

What is measured and what are the consequences? – An early clinical study



Gustav III., King of Sweden from 1771 to 1792:

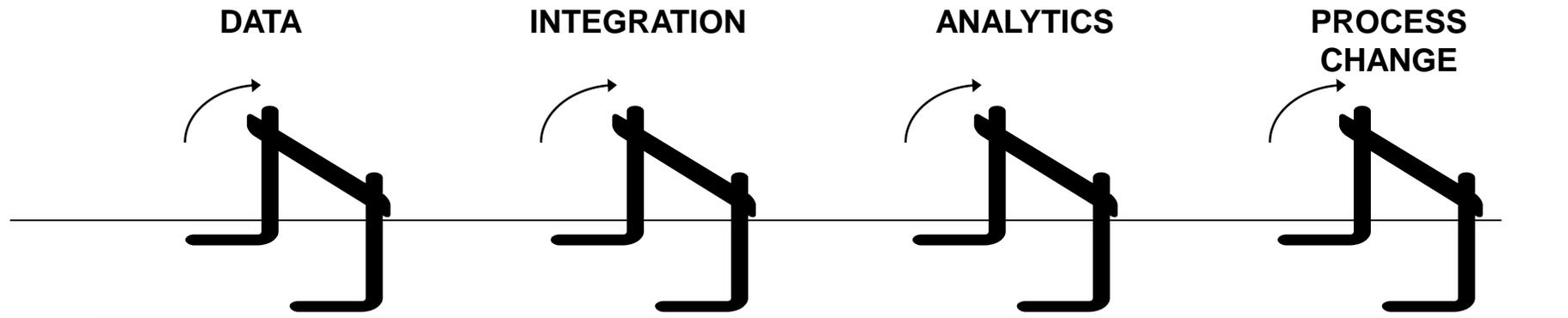
A “controlled study” about finding evidence of the detrimental effects of drinking coffee:

- One convicted murderer had to drink coffee for the rest of his life
- Another one had to drink tea for the rest of his life
- Two physicians supervised the study
- First one physician died
- Gustav III. was assassinated in 1792
- The second physician died
- The tea drinker died at age 83
- The coffee drinker outlasted all of them

**In 1822 drinking coffee was prohibited in Sweden**

An early clinical trial, *Ann. Int. Med.* 117, 1, 30 (1992)

# Hurdles to Reaching the Promise of Digital Health



We are creating millions of useful data points, from a wide variety of sources...

...But the data is provided in separate solutions which prevent getting a holistic view of the patient.

**FREEING DATA  
AND  
INTEGRATING  
DATA ARE KEY**

Predictive analytics has arrived...Natural language processing will become a commodity...  
...But working with only part of the data

Analytics alone cannot transform healthcare. Analytics need to create actions. Culture change, behavior change, process changes are hard to execute.

# Better data for better analytics



**Prescriptive:**  
How can we make it happen?

**Predictive:**  
What will happen?

**Diagnostic:**  
Why did it happen?

**Descriptive:**  
What happened?

**Hindsight**

**Insight**

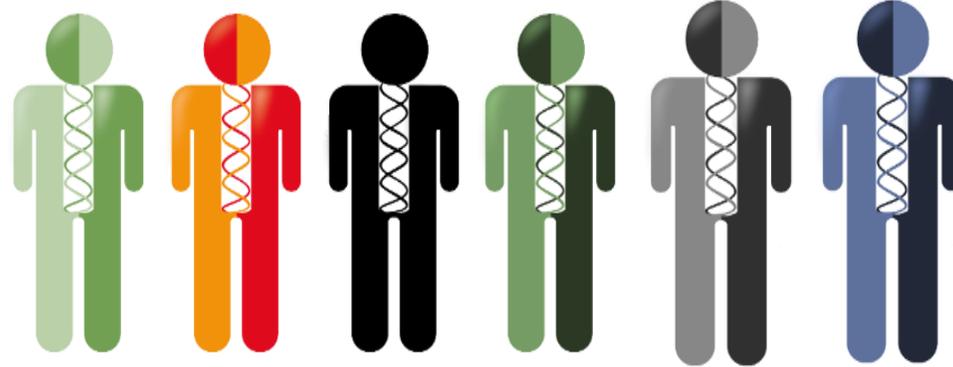
**Foresight**

# Problem to solve

There are ~7 billion human genomes and each responds differently to drugs

  
too strong

  
interactions



  
doesn't work

  
side effects

not always beneficial



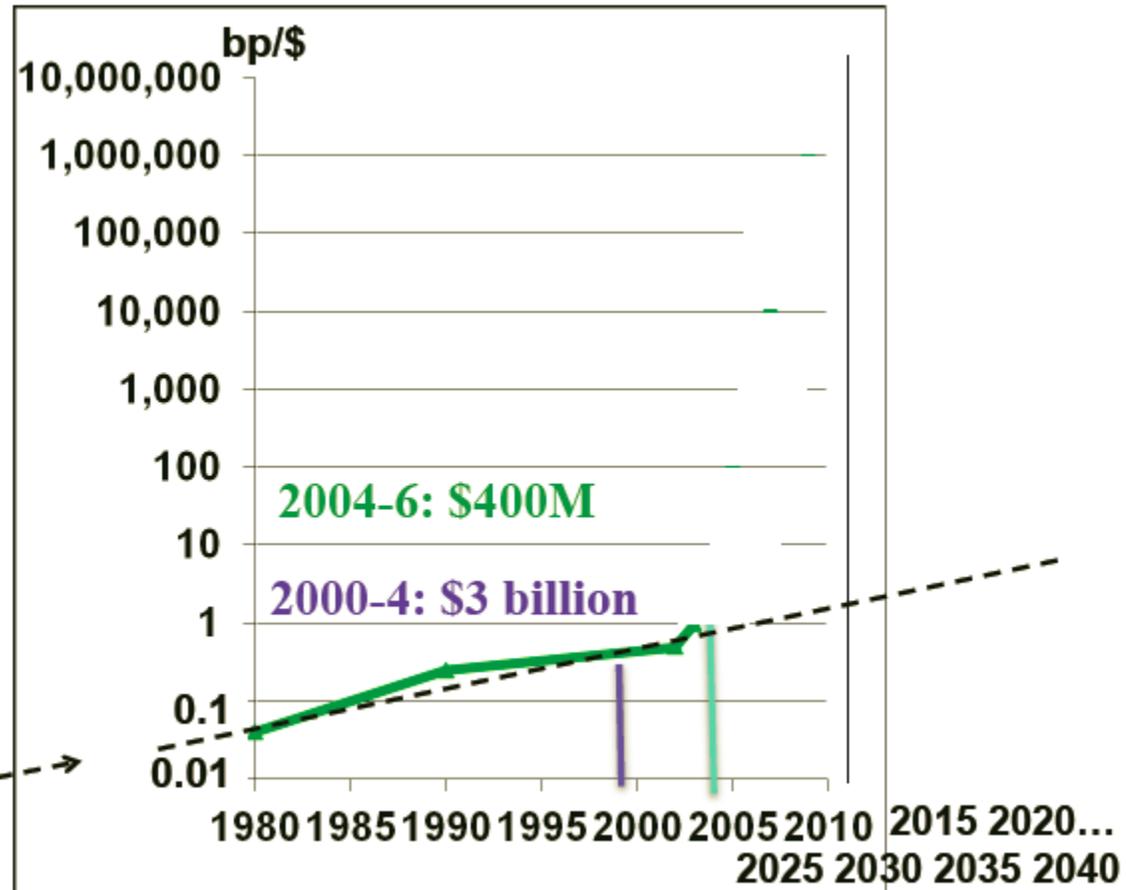
# Genome Sequencing

\$1000  
Genome

When?

2040

-----  
Moore's law  
1.5x/yr for  
electronics



# Genome Sequencing

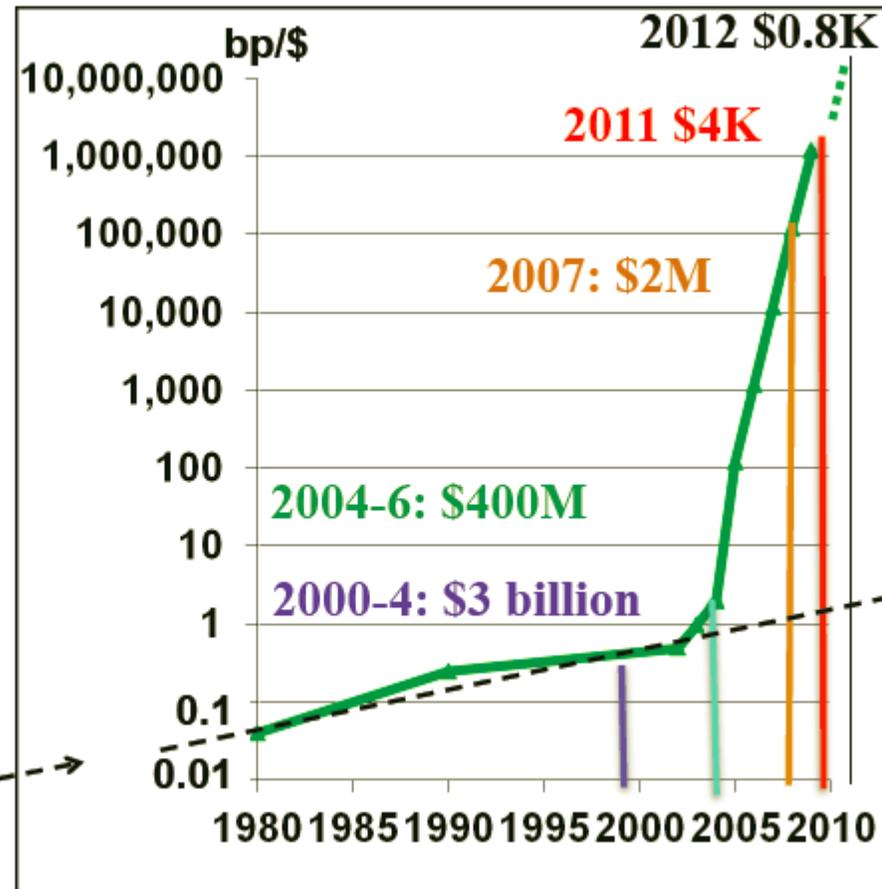
2018 \$0.1K

Factors of  
10/yr

\$1000  
When?

**2012**

-----  
Moore's law  
1.5x/yr for  
electronics



# Cost Reduction - Example



**458 Ferrari Spider - \$398,000 in 2006 –**

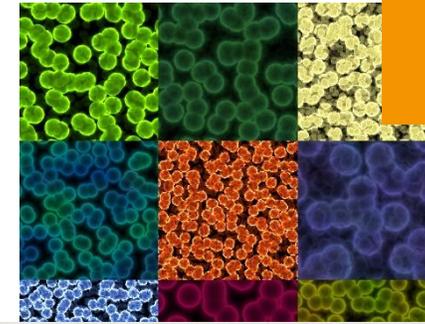
**25 cents now!**



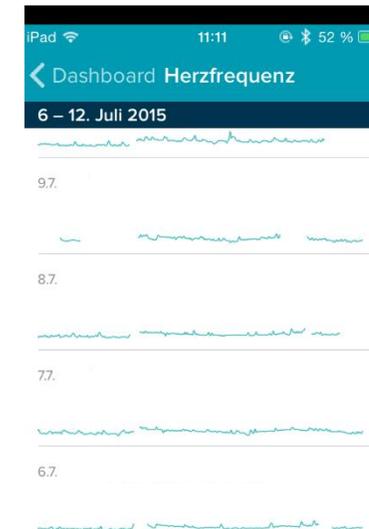
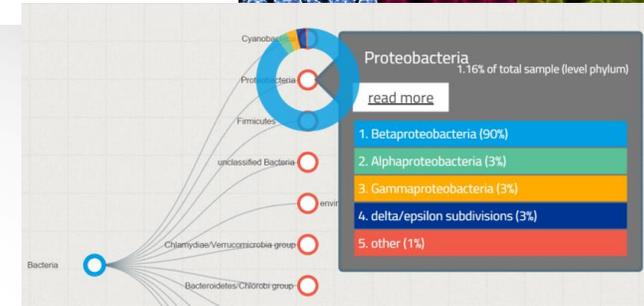
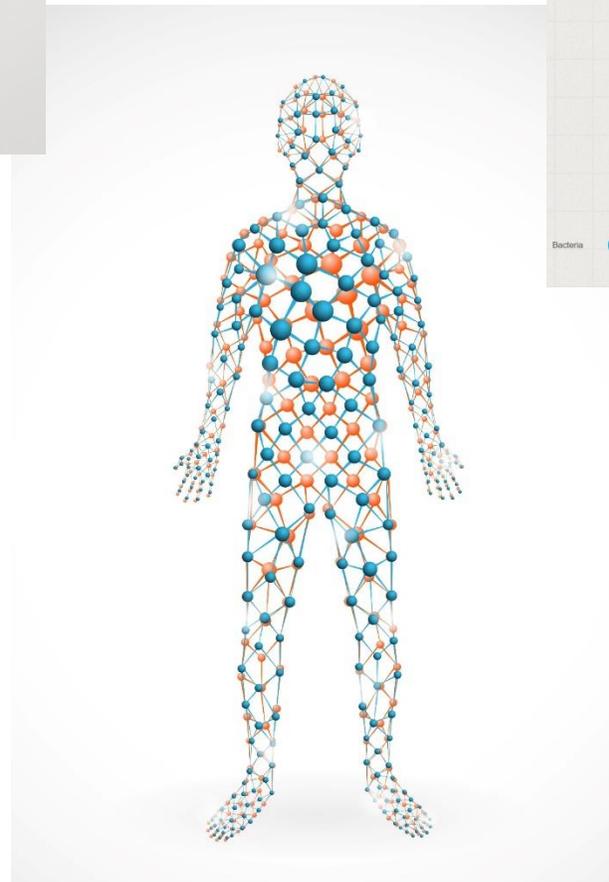
# ➔ Much more data for way less money

Data is growing faster than ever before and by the year 2020, about [1.7 megabytes](#) of new information will be created every second for every human being on the planet.





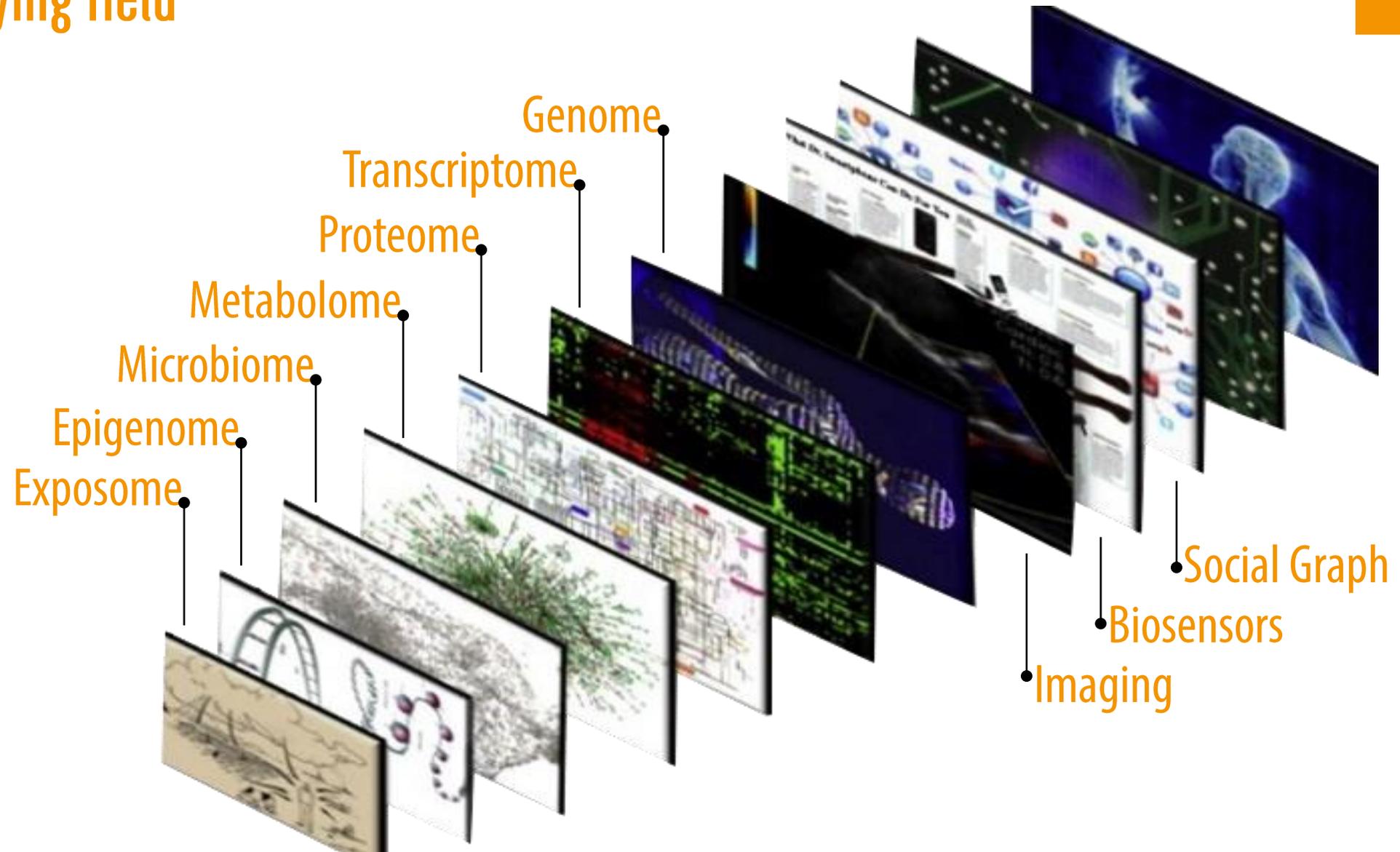
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	<a href="#">Caffeine...more...</a>	3 snps
	<a href="#">Camptosar...more...</a>	1 snp
	<a href="#">Carvedilol...more...</a>	2 snps
	<a href="#">Carbamazepine...more...</a>	3 snps
	<a href="#">Celexa...more...</a>	1 snp
	<a href="#">Cetuximab...more...</a>	1 snp
	<a href="#">Chlorthalidone...more...</a>	1 snp
	<a href="#">Cisplatin...more...</a>	1 snp
	<a href="#">Citalopram...more...</a>	1 snp
	<a href="#">Clopidogrel...more...</a>	1 snp
	<a href="#">Clozapine...more...</a>	1 snp
	<a href="#">Codeine...more...</a>	1 snp
	<a href="#">Crestor...more...</a>	2 snps
	<a href="#">Cyclophosphamide...more...</a>	2 snps
	<a href="#">Desipramine...more...</a>	3 snps
	<a href="#">Dextromethorphan...more...</a>	1 snp
	<a href="#">Docetaxel...more...</a>	2 snps
	<a href="#">Effexor...more...</a>	1 snp
	<a href="#">Elatrol...more...</a>	3 snps
	<a href="#">Elavil...more...</a>	1 snp
	<a href="#">Endep...more...</a>	1 snp
	<a href="#">Escitalopram...more...</a>	1 snp
	<a href="#">Esomeprazole...more...</a>	2 snps
	<a href="#">Finasteride...more...</a>	3 snps
	<a href="#">Flucloxacillin...more...</a>	1 snp
	<a href="#">Fluticasone propionate...more...</a>	2 snps
	<a href="#">Gefitinib...more...</a>	1 snp
	<a href="#">Herceptin...more...</a>	2 snps
	<a href="#">Ibuprofen...more...</a>	1 snp
	<a href="#">Infliximab...more...</a>	2 genosets 4 snps
	<a href="#">Interferon...more...</a>	1 snp
	<a href="#">Iressa...more...</a>	1 snp
	<a href="#">Irinotecan...more...</a>	7 snps
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	<a href="#">Laroxyl...more...</a>	4 snps
	<a href="#">Lipitor...more...</a>	1 snp
	<a href="#">Losec...more...</a>	1 snp
	<a href="#">Methadone...more...</a>	3 snps
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	<a href="#">Metoprolol...more...</a>	1 snp
	<a href="#">Modafinil...more...</a>	2 snps
	<a href="#">Morphine...more...</a>	1 snp
	<a href="#">Naltrexone...more...</a>	1 snp
	<a href="#">Naproxen...more...</a>	1 snp
		2 genosets 4 snps



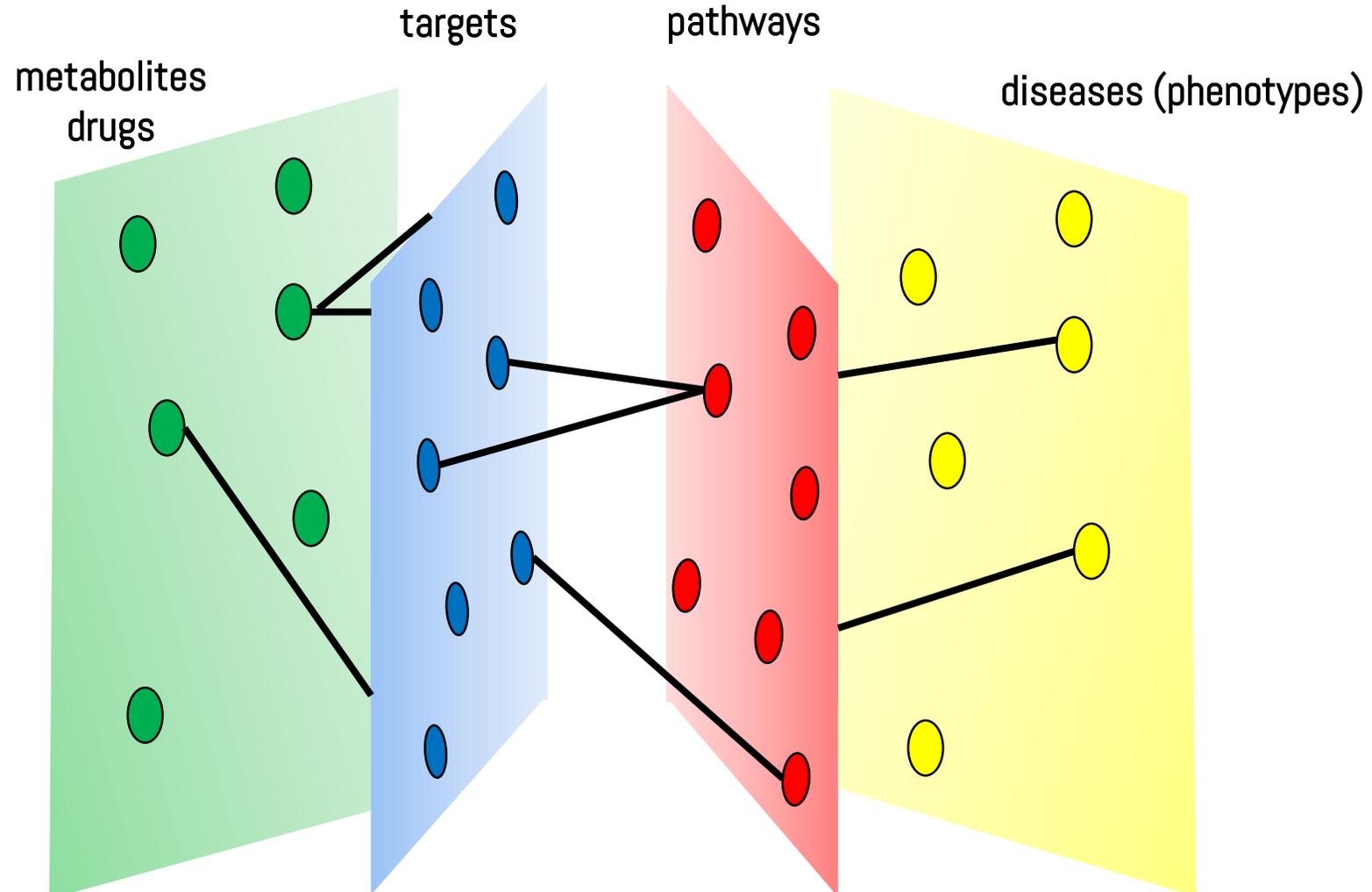
KENKODO



# Our playing field



# Context matters!



# Need for interpretation



## Metabolomics analysis for biomarker identification

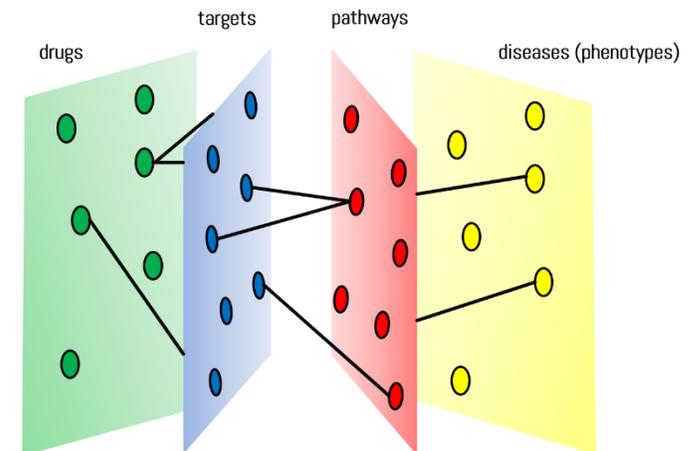


- Metabolomic data for 30 oncology patients, 15 responders, 15 non-responders
- With some pathway info we developed a simple decision tree that relies on only 3 metabolites to distinguish responders vs. non-responders
- These metabolites are all affected around catabolism for a certain amino acid

➔ Supported by new proteomics data



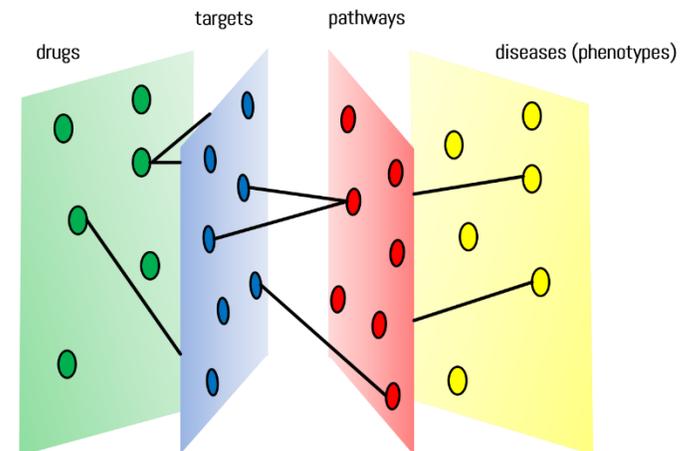
[www.biovariance.com](http://www.biovariance.com)



# From transcriptome to metabolomic biomarker



- Starting point: Gene expression data from diseased vs. healthy patient, treatment info
- Determine gene signature for diseased
- Map into pathway information
- Extract metabolite information from public sources, determine possible biomarker



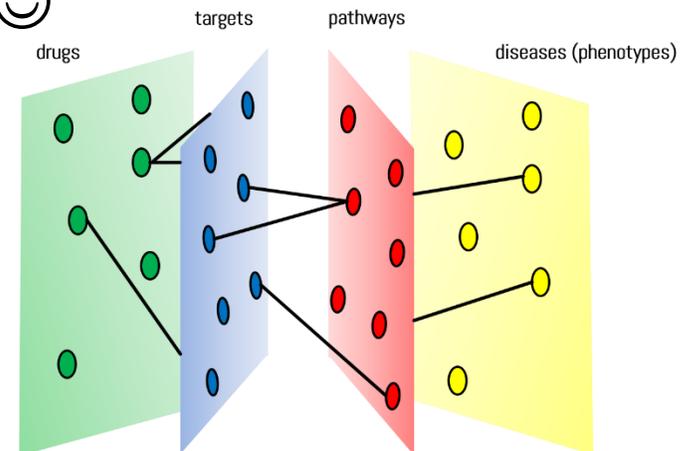
# Gene Expression Analysis for Target Finding and Resistance



- Treated/untreated expression data from 4 cancer cell lines (sensitive and resistant)
- Build and use analysis pipeline
- Developed both target and resistance hypothesis
- Target hypothesis validated in experiment ☺



[www.biovariance.com](http://www.biovariance.com)



## Complex multiomics analysis for target and biomarker finding

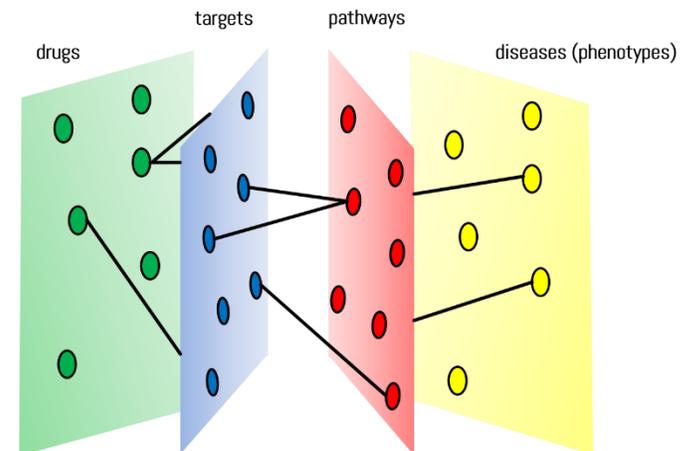


- Various datasets (>80 cell line test from various providers with expression data)
- Integrated with pathway and biochemical activity data
- Proteomics data
- Sequence data, some mutation data
- Public information

- First validation results look promising



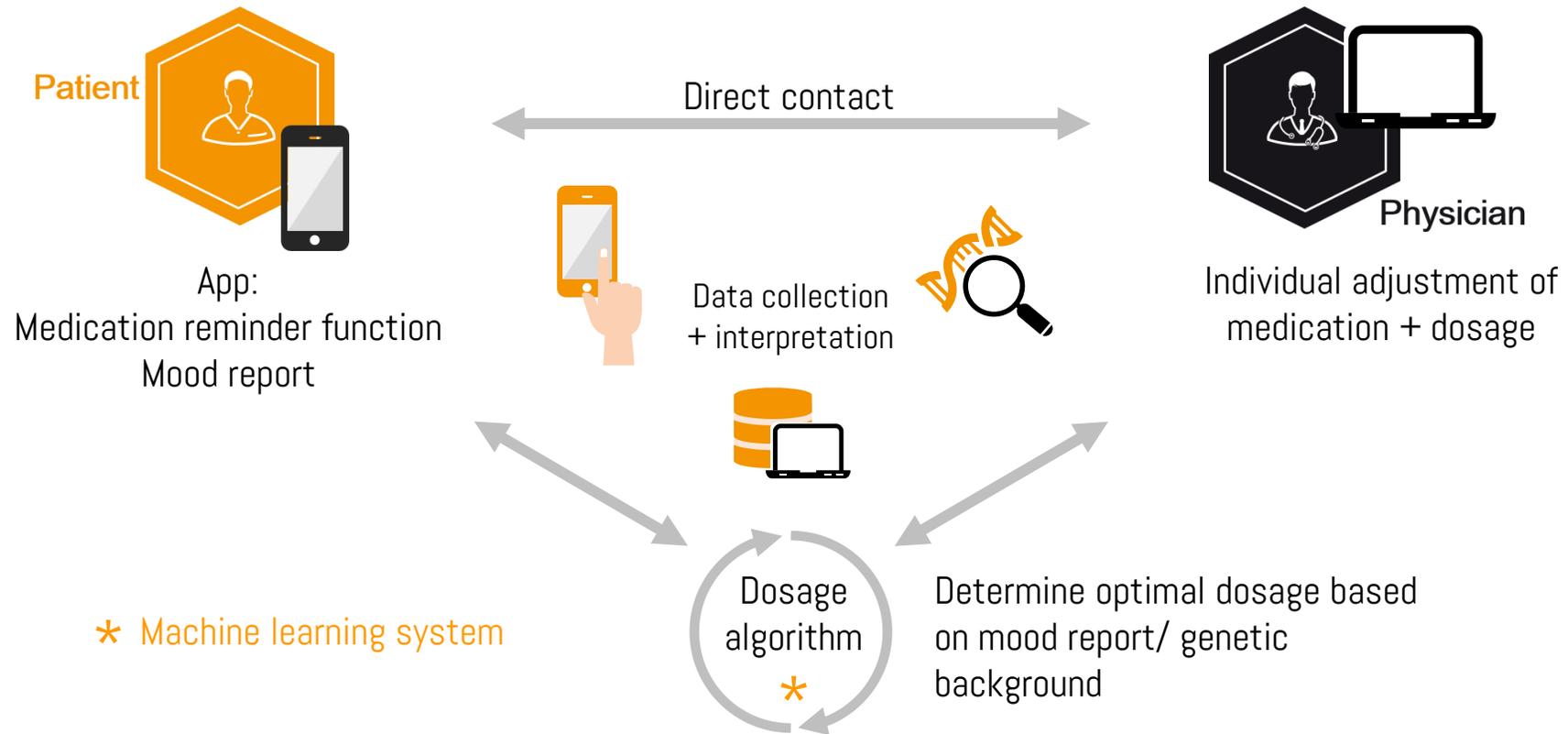
[www.biovariance.com](http://www.biovariance.com)



# Digital health: Precision medicine

Focus Psychiatry: Implementation

Making practical knowledge accessible



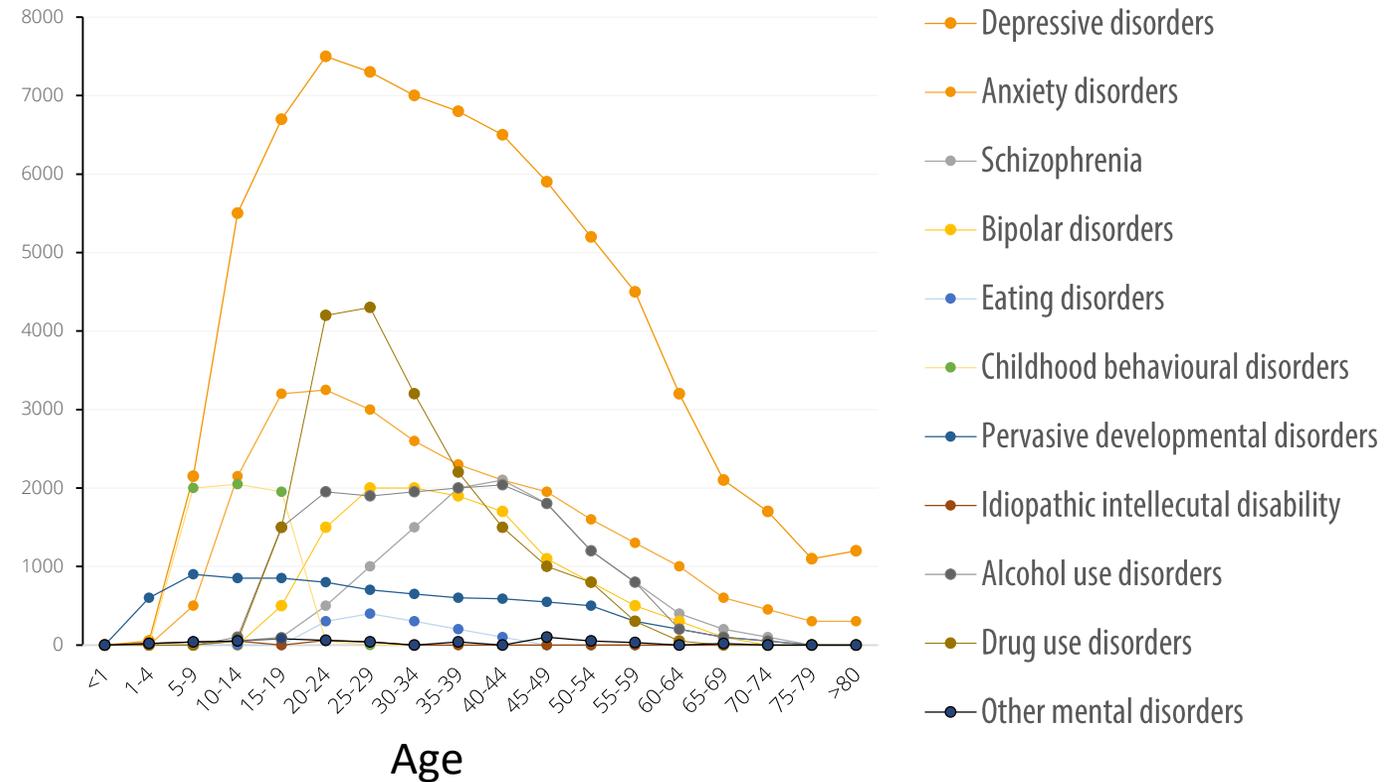
→ Find best medication + dosage for individual patients based on their genetic background

# Focus Psychiatry – Clinical Issue: Polypharmacy



Psychiatric diseases are

- Serious diseases
- Early onset (children, teenagers)



# Focus Psychiatry: Implementation

Making Practical Knowledge accessible



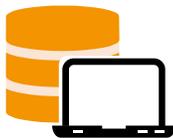
## Data from 1000 patients

Clinical, medication and genetic data collection



## Data collection platform

Systematic Interpretation, literature research and standardization

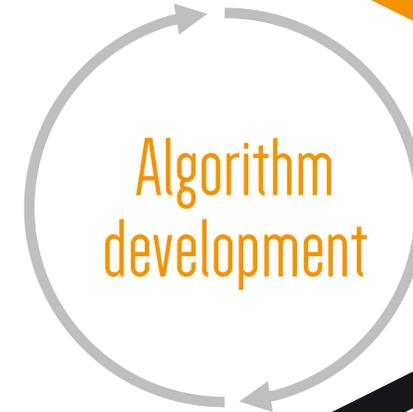


## Systematic literature research

Development data collection platform, dosage algorithm and apps



Patient



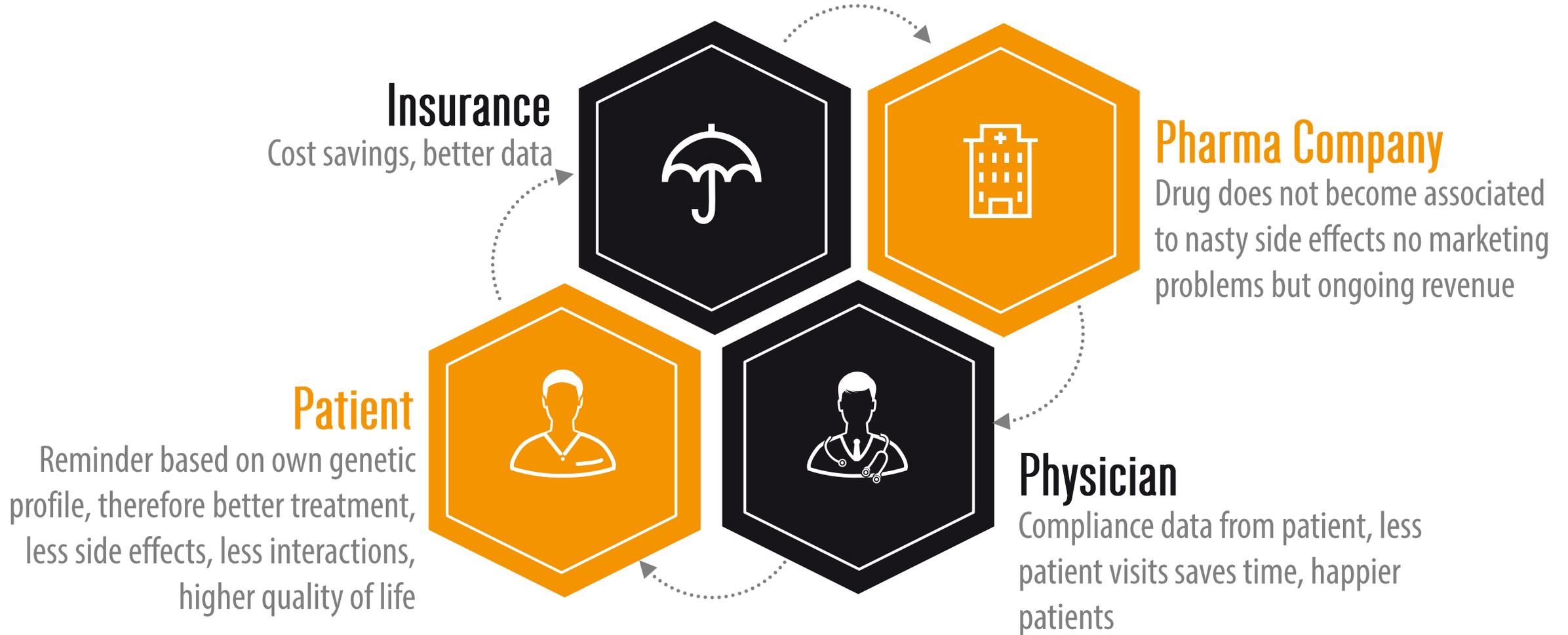
SAAS platform



Physician



# Win-win-win-win-situation



# Acknowledgement

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Questions?



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