

The background image shows a person lying on a table inside an MRI scanner. The room is dimly lit with blue tones. There are monitors and medical equipment visible in the background. The text is overlaid on the left side of the image.

**iMinds Department
MEDICAL IT**

**Health
Data Analytics
and
Decision Support**

Prof.Dr. Bart De Moor

Bart.DeMoor@iminds.be

A photograph showing two women in a clinical or office setting. The woman on the left, wearing a grey turtleneck and glasses, is pointing at a tablet held by the woman on the right. The woman on the right is wearing blue scrubs and has her hair in a bun. The background is a plain, light-colored wall.

Department Med IT

Trends

P3 x P4 medicine

**Decision support
cases**

MEDICAL IT DEPARTMENT

207

PhD students

10

PhDs /
year

200

papers / year

4

Nature papers

21

PIs

10

PI H-index > 25

9

RM

8

Patents

8

Health spinoffs



A photograph showing two women in a clinical or office setting. The woman on the left, wearing a grey turtleneck and glasses, is pointing at a tablet held by the woman on the right. The woman on the right is wearing blue scrubs and has her hair in a bun. The background is a plain, light-colored wall.

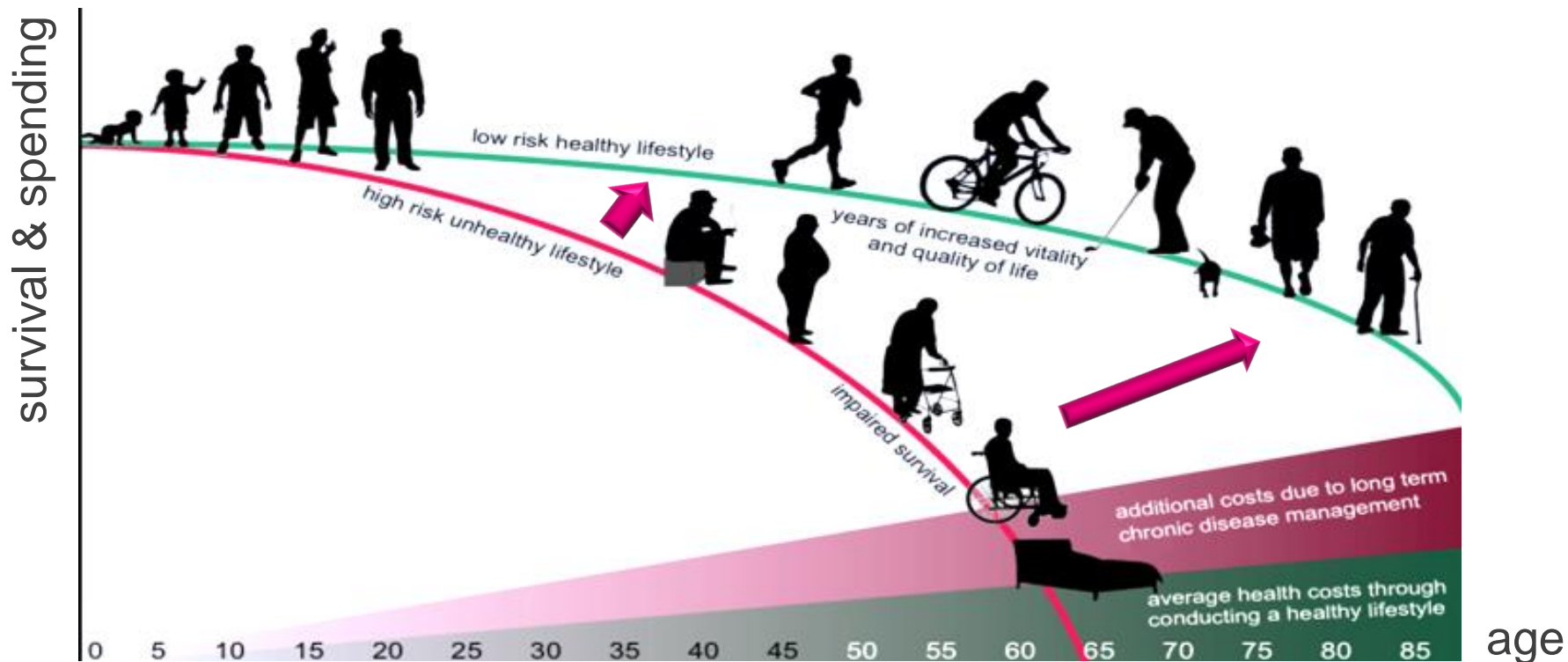
Department Med IT

Trends

P3 x P4 medicine

**Decision support
cases**

DEMOGRAPHY & COSTS



TECHNOLOGY FOR EVOLVING NEEDS

Sport enthusiasts



Healthy people



People at risk



Fragile People



Chronically III



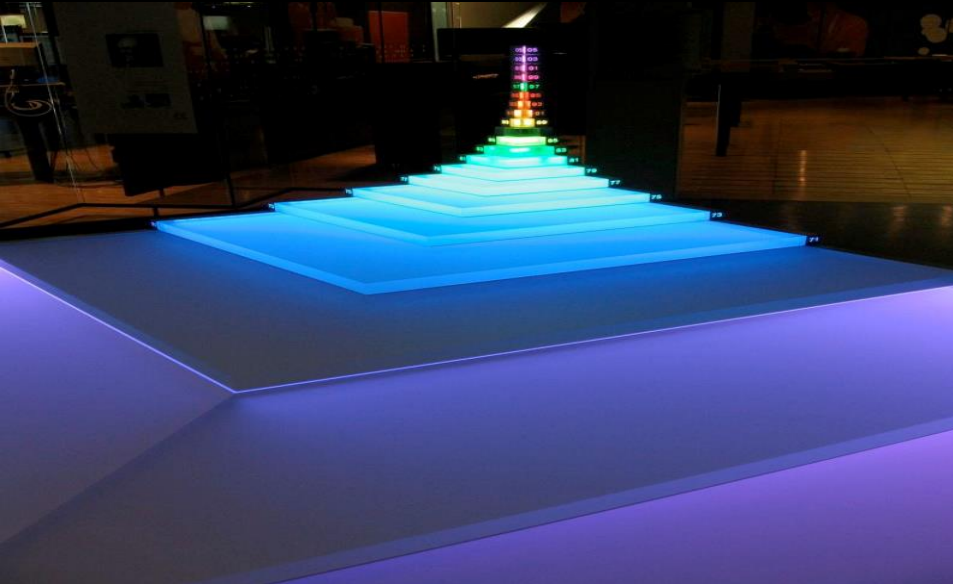
Acutely III



Active Lifestyle
Support Solutions

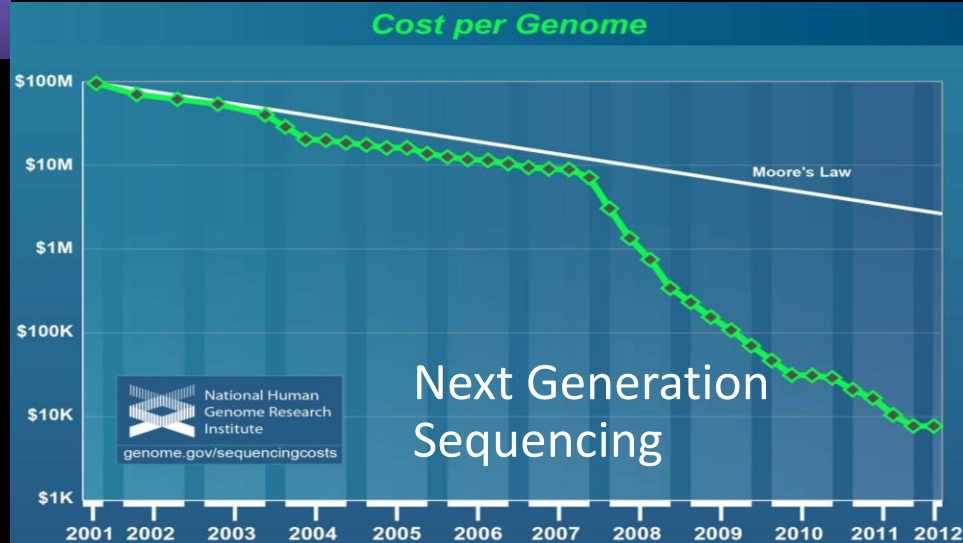
Lifestyle Management/
Preventive Healthcare Solutions

Remote (Patient) Monitoring and
Specialized Treatment Solutions

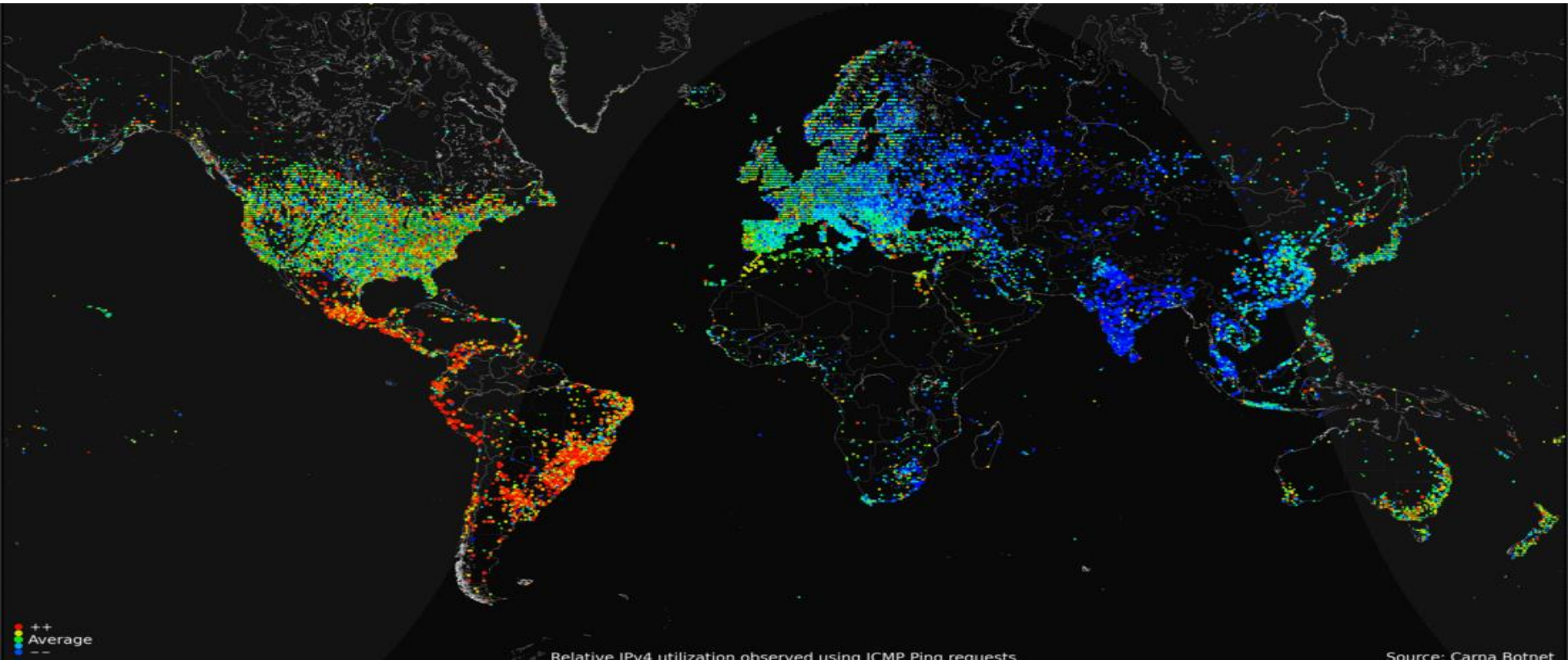


Moore's law:
computing power
doubles
every 18 months

Carlson's law:
complexity/cost
evolves
exponentially



WWW





Grains of rice the world consumes annually: **27.5 quadrillion**



Amount of data the world consumes every 30 minutes: **40.4 petabytes**

We consume more bytes on the internet in 30 minutes than grains of rice in a year.

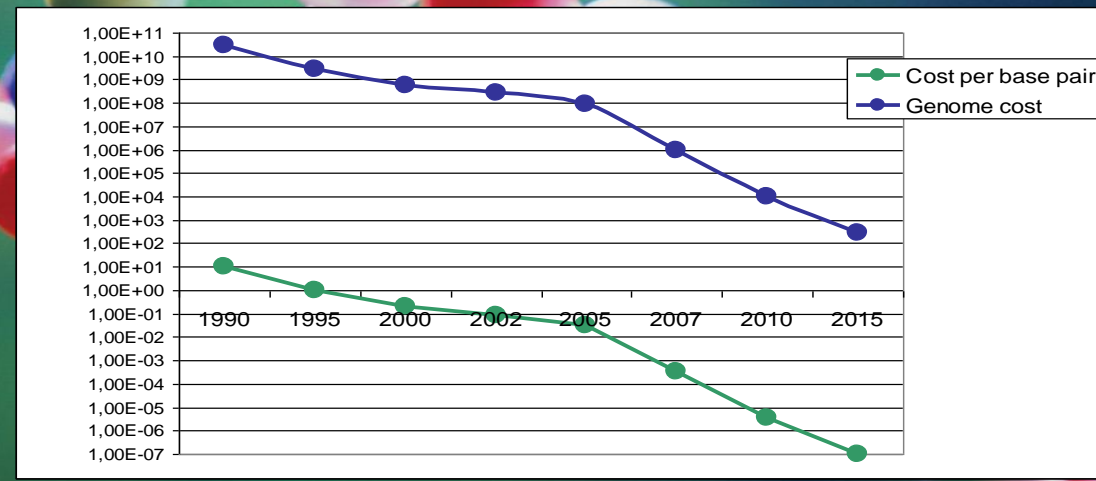
1 million = 1 000 000	1 kB = 1 000	1 TB
1 billion = 1 000 000 000	1 MB = 1 000 000	= large university library
1 trillion = 1 000 000 000 000	1 GB = 1 000 000 000	= 212 DVD discs
1 quadrillion =	1 TB = 1 000 000 000 000	= 1430 CDs
1 000 000 000 000 000	1 PB = 1 000 000 000 000 000	= 3 year music in CD quality

GENOME DATA

- **Human genome project (2003)**
 - 13 year project
 - \$300 million value with 2002 technology
- **Personal genome (2007)**
 - Genome of James Watson, 2 months
 - \$1 000 000
- **€1000-genome**
 - Expected 2012-2020



GS-FLX Roche
Applied Science 454
Sequencers



TSUNAMI OF MEDICAL DATA

sequencing all newborns
by 2020 (125k births /
year)

125 PetaByte / year

index of 20
million
Biomedical
PubMed
records

23 GigaByte

1 small
animal
image

1
GigaByte

1 CD-ROM

750
MegaByte

1 slice mouse
brain MSI at
10 μ m
resolution

81 GigaByte

raw NGS data
of 1 full genome

1 TeraByte

PACS
UZ Leuven

1,6 PetaByte

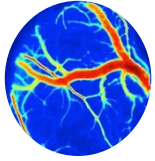
Genomics core
HiSeq 2000 full
speed exome
sequencing

1 TeraByte / week



3P x 4P
MEDICINE

DATA-DRIVEN 3P MEDICINE



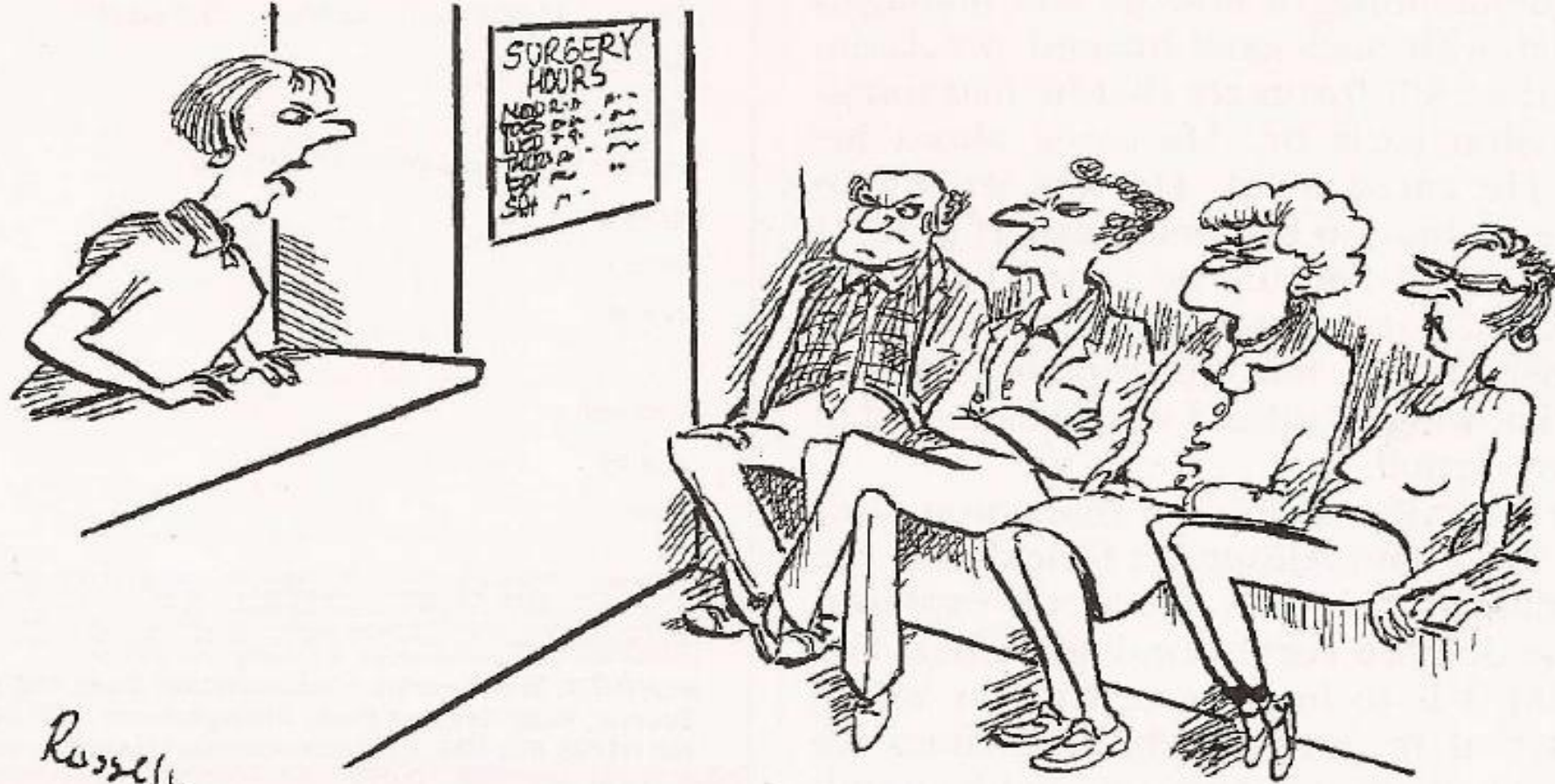
PROFESSIONALS: Clinicians, Researchers, ...



PATIENTS: Empowerment, Associations, ...



POLICY MAKERS: Hospitals, Health Insurance, Social Security, ...



Russell.

'The doctor will see anyone who hasn't already self-diagnosed on the internet.'

DATA-DRIVEN 4P

MEDICINE



PERSONALIZED "customized" diagnosis and treatment



PREVENTIVE better than curation



PREDICTIVE determine risk profiles & predict outcome



PARTICIPATORY involve the patient

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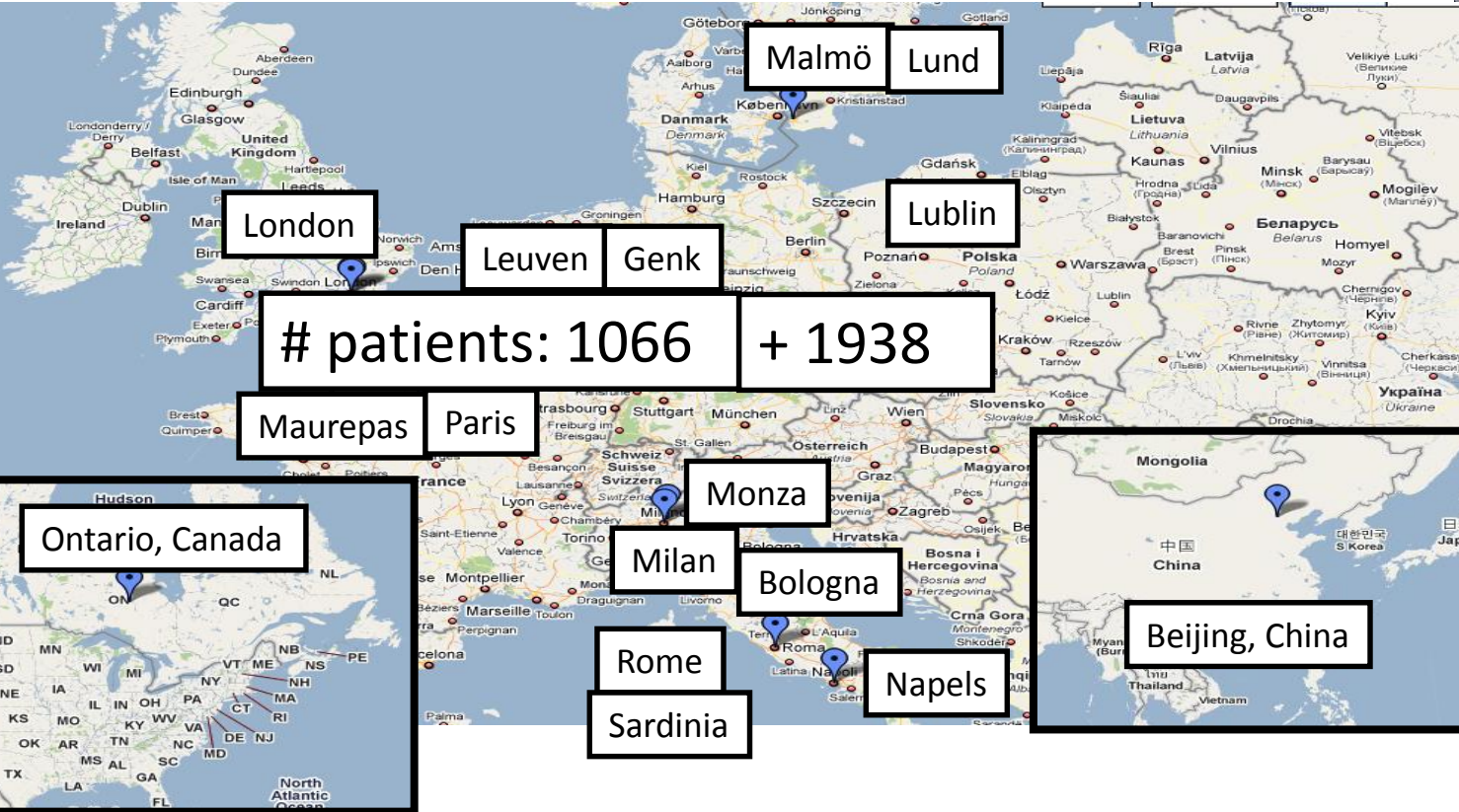
Department Med IT

Trends

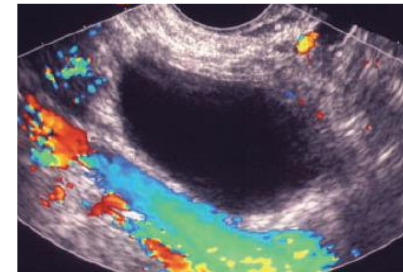
P3 x P4 medicine

**Decision support
cases**

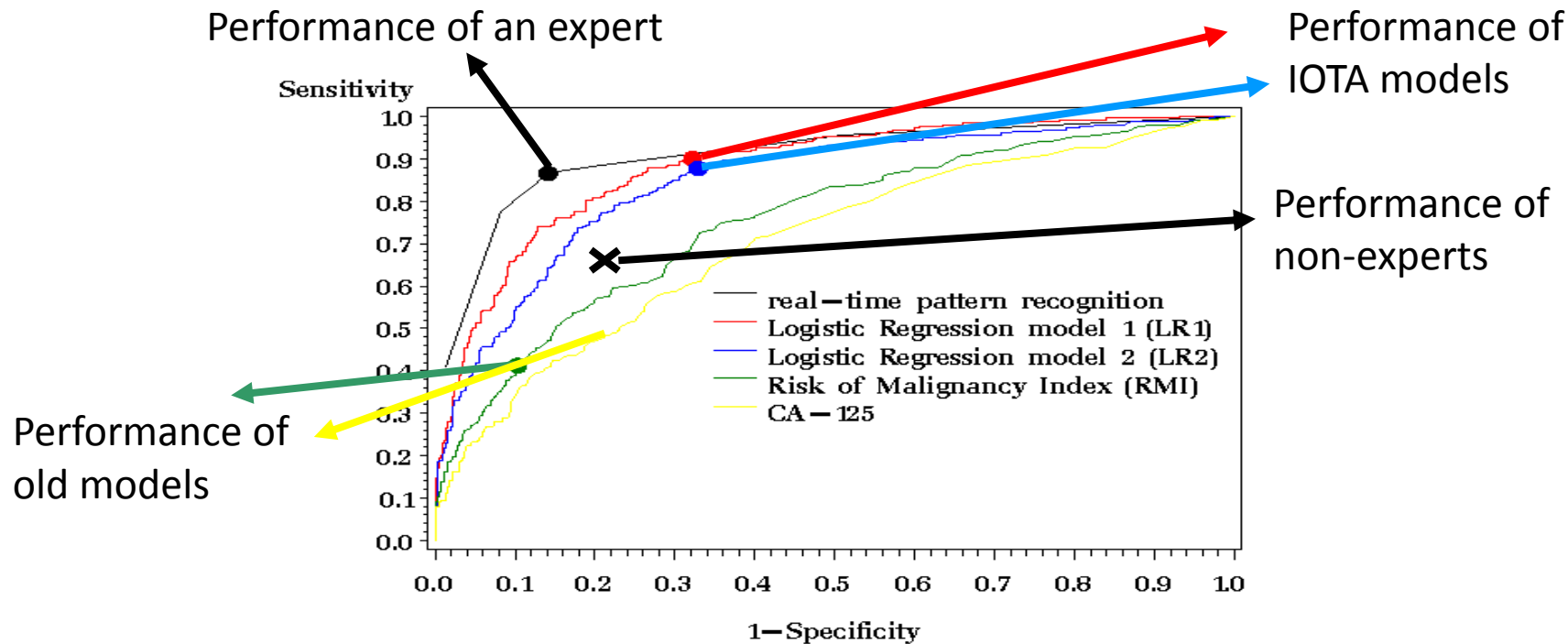
PARTICIPATORY



IOTA app:
population
based
assessment
of ovarian
tumour malignancy:

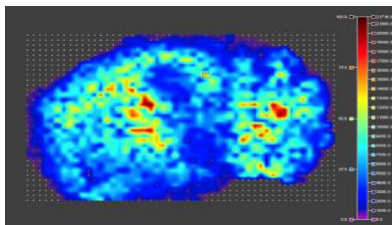
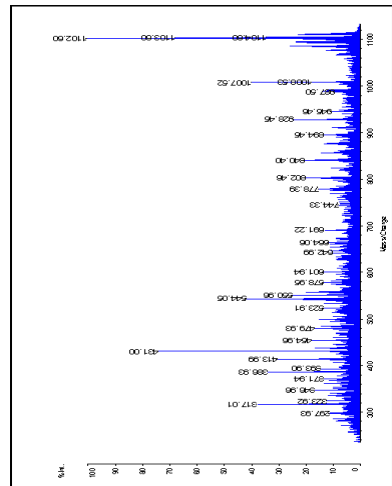
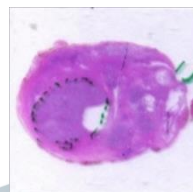
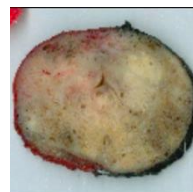
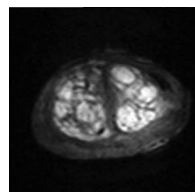
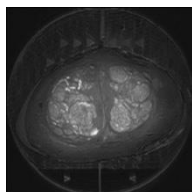
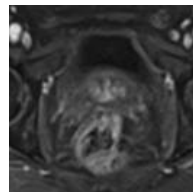
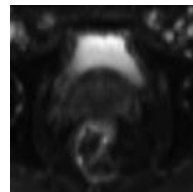
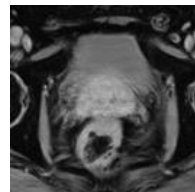
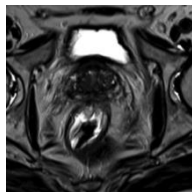
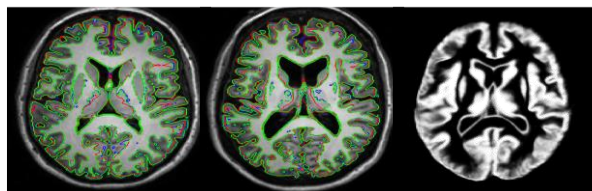
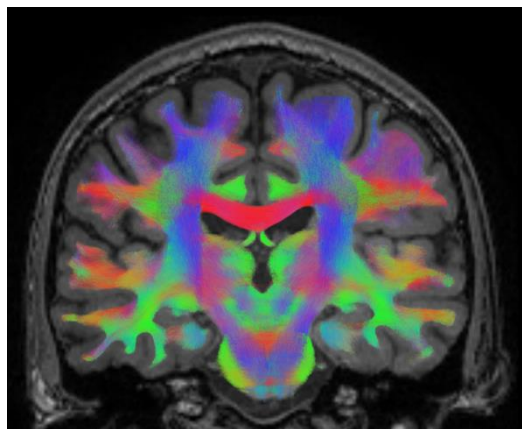
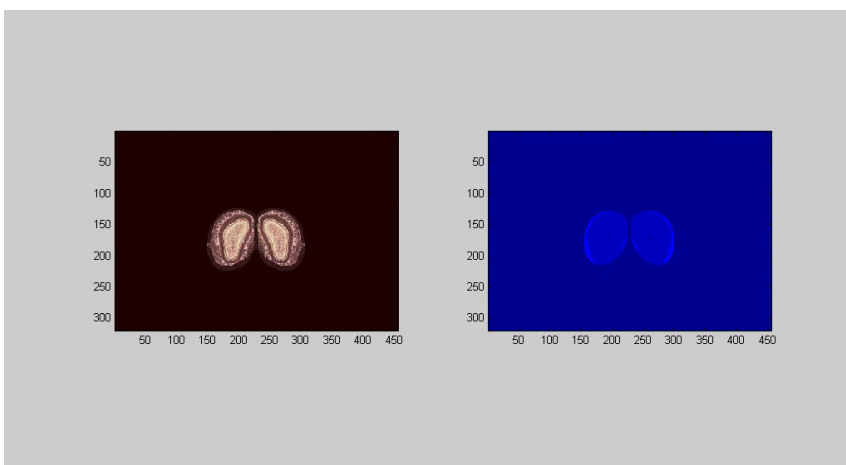


PERFORMANCE



You share, we care !

PREDICTIVE



PERSONALIZED

with



LOGIC-Insulin

Tight Glycemic Control in intensive care lowers mortality

Control algorithm LOGIC-Insulin ('automated customized patient pilot')

400 clinical trials



GEPLUKT UIT THE NEW YORKER



'Hij wordt wakker! Iedereen terug op zijn plaats!'

PREVENTIVE



ACACATTAATCTTATATGCTAAAAC TAGGTCTCGT
TTTAGGGATGTTTATAACCATCTTTGAGATTATTGA
TGCATGGTTATTGGTTAGAAAAAATATACGCTTGTT
TTTCTTTCTAGGTTGATTGACTCATA CATGTGTTT
ACTTAACAAAAC TGCAC TTTT
ACTTTAAAAGTGATCAAAGTA
AATATAAAGACATTTGTTTCAA
ACAATATCAAGAAGACAAAA
TCAGGAAGCATATATATTACA
TTTTTGTAAATCAACACCGACCA
ACATTAATCTTATATGCTAAA
TAGGGATGTTTATAACCATCTT
CATGGTTATTGGTTAGAAAAA
TCTTTCTAGGTTGATTGA



ACACATTAATCTTATATGCTAAAAC TAGGTCTCGT
TTTAGGGATGTTTATAACCATCTTTGAGATTATTGA
TGCATGGTTATTGGTTAGAAAAAATATACGCTTGTT
TTTCTTTCTAGGTTGATTG
CATTGAGGAAGGAACTTAA/
TCAACGTCACAGCTACTTT/
TATCAAGAAAGCTTAATATA
GGTTTCGTAAGTGCACAAT/
TGACTAATTTTGT TTTTCAGG
CGAACACAAAATCTATTTTTC
TGGTTTCGATTACACACATT/
ACTAGGTCTCGTTTTAGGG,
TGAGATTATTGATGCATGG
TATACGCTTGTTTTCTTTCT

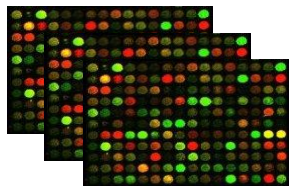


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TGCATGGTTATTGGTTAGAAAAAATATACGCTTGTT
TTTCTTTCTAGGTTGATTGACTCATA CATGTGTTT
CATTGAGGAAGGAACTTAACAAAAC TGCAC TTTT
TCAACGTCACAGCTACTTTAAAAGTGATCAAAGTA
TATCAAGAAAGCTTAATATAAAGACATTTGTTTCAA
GGTTTCGTAAGTGCACAATATCAAGAAGACAAAA
TGACTAATTTTGT TTTTCAGGAAGCATATATATTACA
CGAACACAAAATCTATTTTGTAAATCAACACCGACCA
TGGTTTCGATTACACACATTAATCTTATATGCTAAA
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TGAGATTATTGATGCATGGTTATTGGTTAGAAAAA
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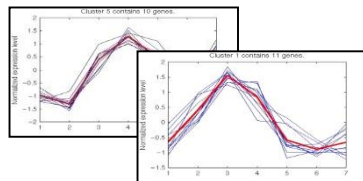


GENOMIC DATA FUSION

High-throughput genomics

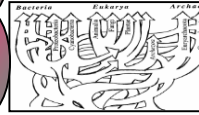
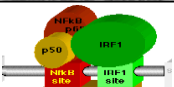
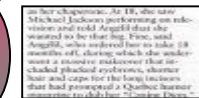
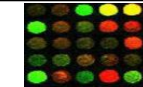
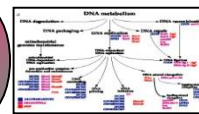


Data analysis

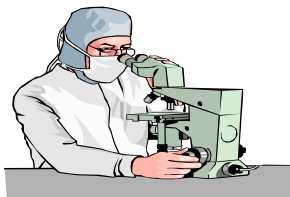


Candidate genes

Information sources



Validation



Candidate prioritization

Rank	En	Ex	Ip	Ke	GO	Te	Avg	Pval
1	TTR	G6PC	PAH	G6PC	IDF1	TTR		TTR
2	IDF1	TTR	IDF1	PAH	PAH	IDF1		PAH
3	CRP	ALB	TTR	RERE	G6PC	CRP		G6PC
4	HOXB6	HABP2	ALB	ERCC3	TTR	HOXB6		IDF1
5	ALB	PAH	HDC	ERCC3		ALB		ALB
6	NR4A2	IF	TLL2	ANKRD3	HMG2	CRP		CRP
7	PAH		CTGR1	ARAF1	HDC	NR4A2		HABP2
8	HOXA11	IDF1	G6PC	PKD2	F13A1	PAH		IF
9	NFYA	CRP	HABP2	MIMR1	KCNN3	HOXA11	C13orf7	FST
10	C9	ARAF1	IF	HDC	CLIC1	NFYA	TTR	ARAF1

Name	Ensembl
TTR	ENSG00000118271
PAH	ENSG00000171759
G6PC	ENSG00000131482
IDF1	ENSG0000017427
ALB	ENSG00000163631
CRP	ENSG00000132693
HABP2	ENSG00000148702
IF	ENSG00000138799
FST	ENSG00000134363
ARAF1	ENSG00000078061
HMG2	ENSG00000149948
C9	ENSG00000113600
FCBP2	ENSG00000111406
HOXB6	ENSG00000108511
RERE	ENSG00000142599
HOXA11	ENSG00000005073
CLIC1	ENSG00000096238
ERCC3	ENSG00000163161
ERCC3	ENSG00000163161
TLL2	ENSG00000095587
SYT4	ENSG00000132872
SYT4	ENSG00000132872
PIK4CB	ENSG00000143393
PKD2	ENSG00000118762
ANKRD3	ENSG00000081026
F13A1	ENSG00000183421
BPAO1	ENSG00000151914
KCNN3	ENSG00000143603
GRIN2A GRIN2B	ENSG00000150086
SIM1	ENSG00000112246
	ENSG00000174891
	ENSG00000099195
C14orf10	ENSG00000092020
STX8	ENSG00000170310
	ENSG00000107671
MSH5	ENSG00000096474
CRH	ENSG00000147571
MID1	ENSG00000101871
	ENSG00000184508
	ENSG00000113460
TGFB3	ENSG00000119699
C1QR1	ENSG00000125810
NR4A2	ENSG00000153234
PDGFC	ENSG00000145431
PDGFC	ENSG00000145431
NR3C2	ENSG00000151623
NFYA	ENSG00000001167
	ENSG00000101898
C8orf4	ENSG00000176907
TM4SF13	ENSG00000106537
MMP3 IMP1	ENSG00000149968

PROFESSIONA

genomic data fusion:
trace disease-causing variants
20x more accurate



Sifrim, Popovic et al,
Nature Methods, 2013

ONDERZOEK

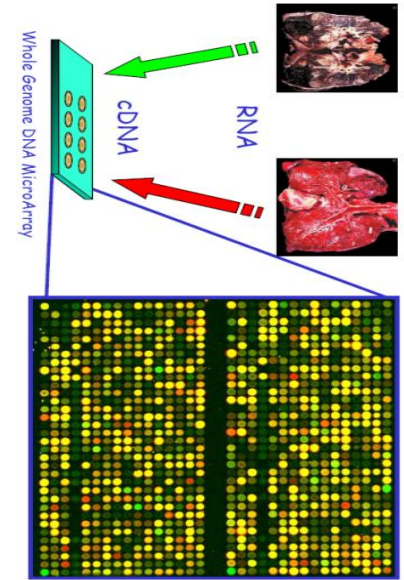
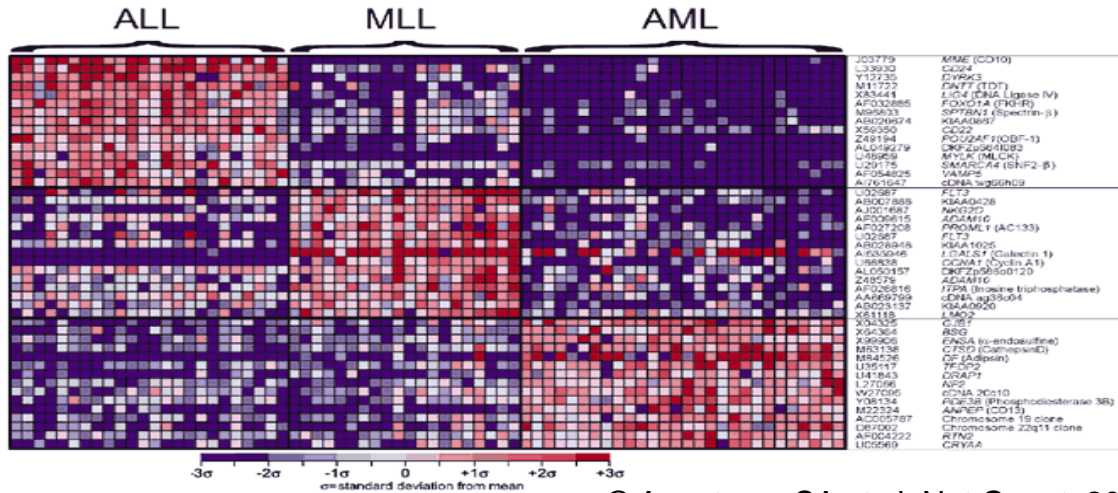
Vlamingen sporen genetische ziektes accrater op

Onderzoekers van iMinds (het vroegere IBBT) en de KU Leuven hebben software ontwikkeld die enorme hoeveelheden genetische data kan doorzoeken en die aanbevelingen doet over de meest waarschijnlijke oorzaak van een erfelijke ziekte. Het 'eXtasy' maakt gebruik van artificiële intelligentie en werkt tot twintig keer beter dan andere software. Volgens professor Yves Moreau zit de software nog in de onderzoeksfase en is nog één tot twee jaar nodig voor de technologie commercieel beschikbaar is.

Bron:
De Tijd, woensdag 23 oktober 2013

<http://homes.esat.kuleuven.be/~bioiuser/eXtasy/>

PREDICTIVE Genetic Biomarkers For Leukemia

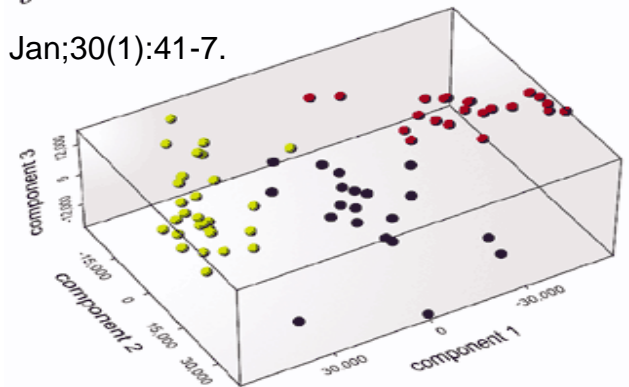


12 600 genes

72 patients

- 28 Acute Lymphoblastic Leukemia (ALL)
- 24 Acute Myeloid Leukemia (AML)
- 20 Mixed Linkage Leukemia (MLL)

© Armstrong SA et al. Nat Genet. 2002 Jan;30(1):41-7.



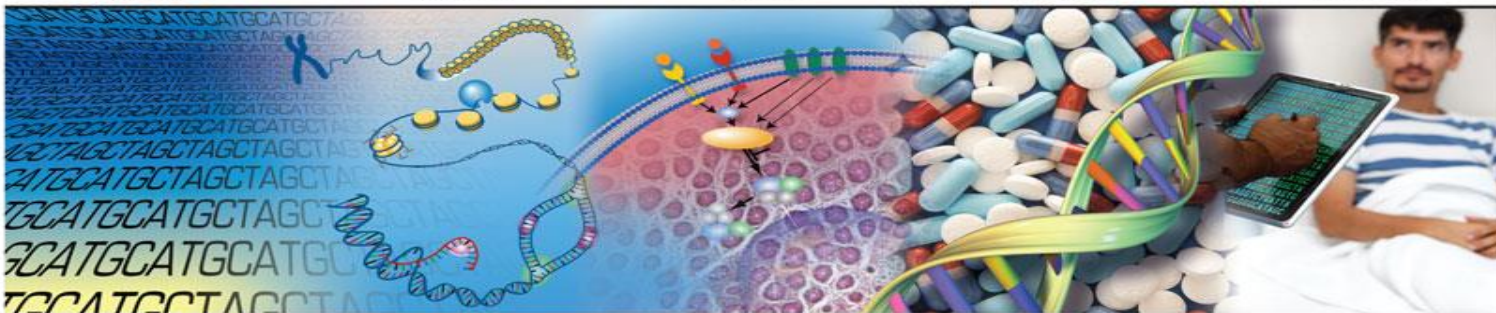
Understanding
the structure of
genomes

Understanding
the biology of
genomes

Understanding
the biology of
disease

Advancing
the science of
medicine

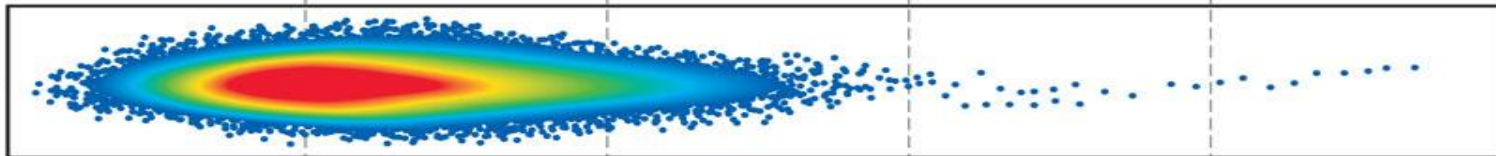
Improving the
effectiveness of
healthcare



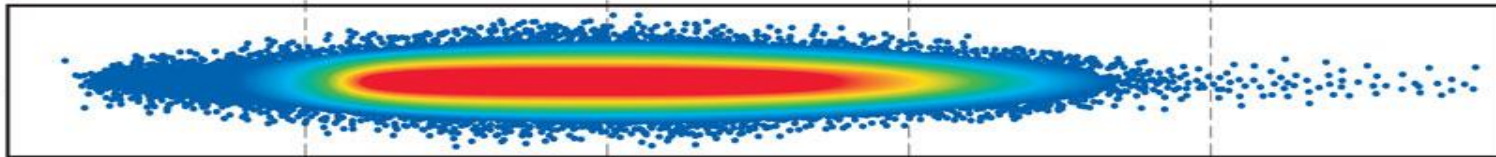
1990–2003
Human Genome Project



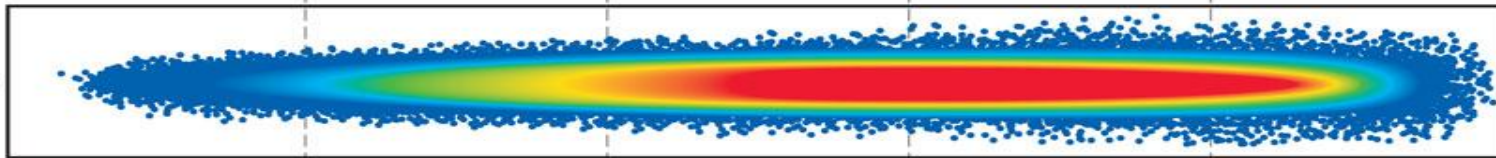
2004–2010



2011–2020



Beyond 2020



POLICY

Social security data mining
for **evidence-based policy decision making**



- Mining @ CM to detect diabetes risk from billing data
- Model & visualize current health care mechanisms (resources, consumption, outliers, ...)
- Deduce optimal policy changes & best practices (in e.g. prescription behaviour)
- Mine RIZIV ? !

iMinds MEDICAL IT

Trends

KU LEUVEN

 Universiteit
Antwerpen


UNIVERSITEIT
GENT



www.iminds.be/medicalit

P3 x P4 medicine

Decision support
cases

