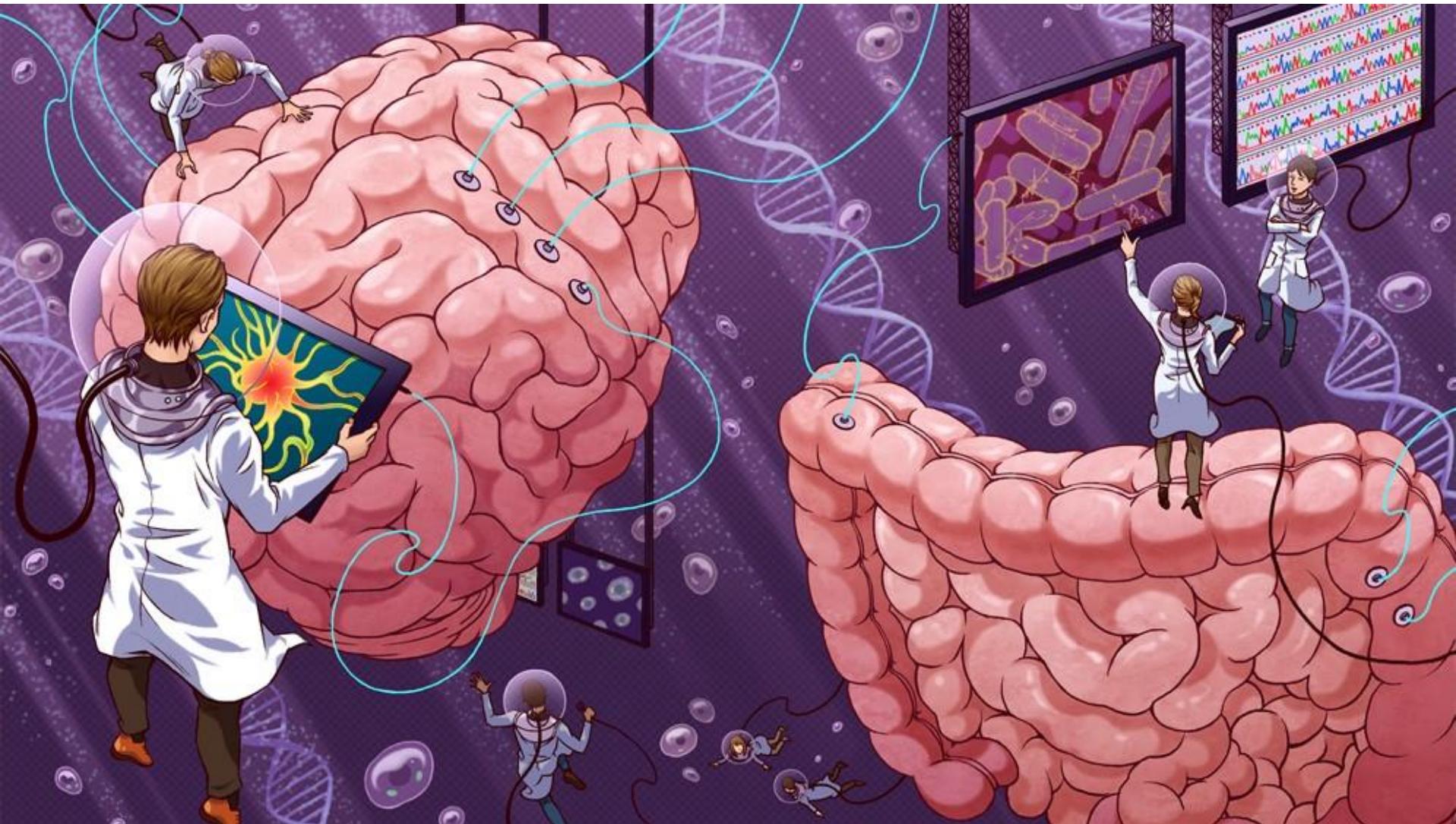


# Big Data Driven Healthcare

충북대학교병원 내분비내과 최형진



# Contents

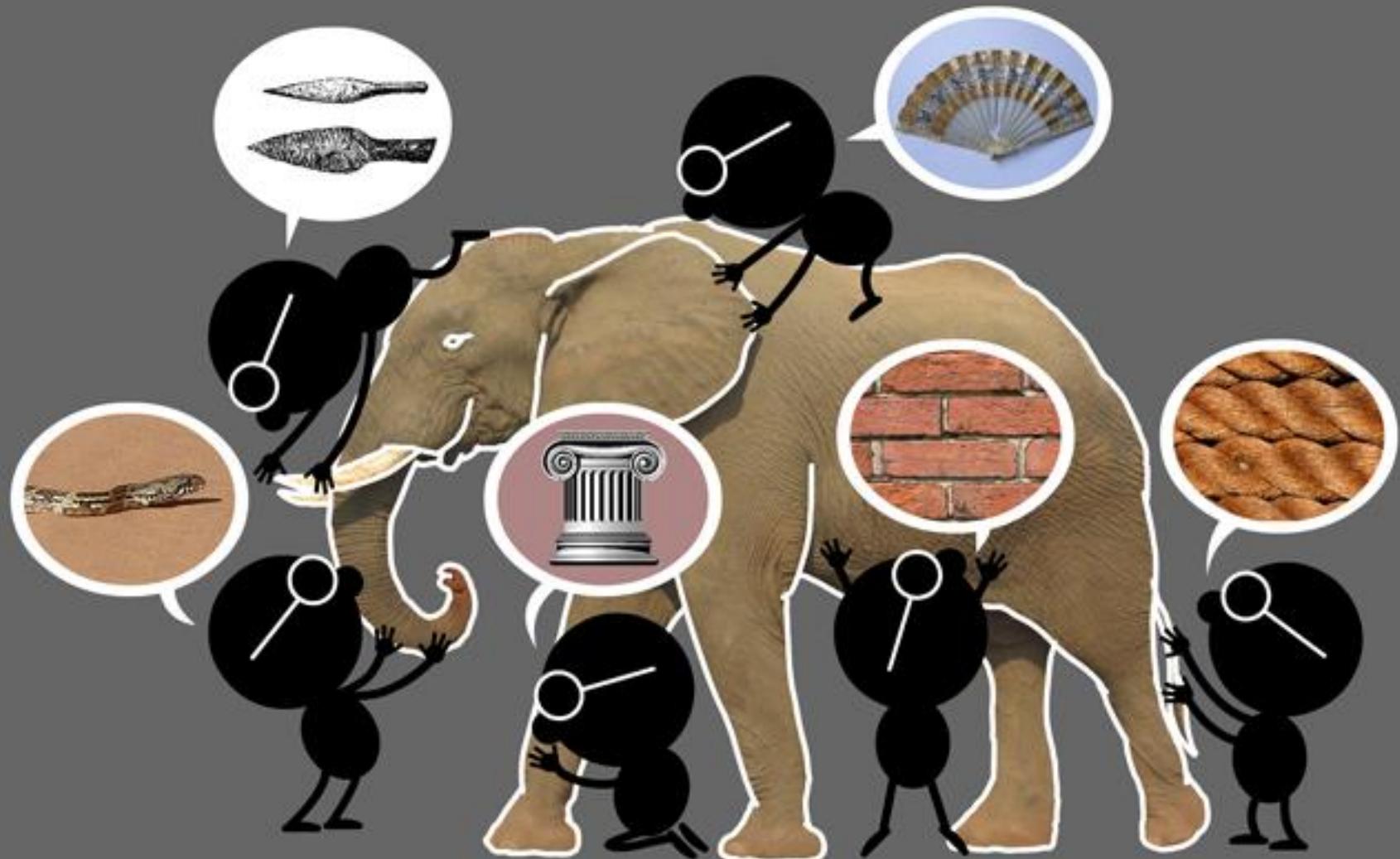
## 1. What is Big Data? 2. Healthcare Big Data

- ① Electrical Health Records (EHR)  
    Structured/Unstructured Data
- ② Medical Images
- ③ National Healthcare Data
- ④ Behavior/Sensor Data
- ⑤ Genetic Data

## 3. Clinical and Research Applications



# What is Big Data?



**Big data is like teenage sex:  
everyone talks about it,  
nobody really knows how to do it,  
everyone thinks everyone else is  
doing it, so everyone claims they  
are doing it...**

(Dan Ariely)

# ICE/ENDO 2014

JUNE 21-24



CHICAGO

## Navigating Biomedical Big Data

## 미국 내분비 학회

Program: Symposia  
Translational Session

Tuesday, June 24, 2014: 11:15 AM-12:45 PM

W178 (McCormick Place West Building)

Chair:

M Susan Smith, MS, PhD, OR National Primate Rsrch Ctr, Oregon Health & Science University, Beaverton, OR

11:15 AM S77-1

**Big Data from Small Data: Linking & Accessing Biomedical Big Data**  
*Maryann E Martone, PhD, UCSD*

11:45 AM S77-2

**Making Sense of Genomic Data to Advance Genomic Medicine**  
*Alan R Shuldiner, MD, Department of Medicine, Univ of Maryland, Baltimore, MD*

12:15 PM S77-3

**Linking and Accessing Big Data for Translation to Clinical Medicine: The Cancer Genome Atlas**  
*Thomas J Giordano, MD, PhD, Pathology, Internal Medicine, University of Michigan, Ann Arbor, MI*



# ASBMR® 2014 Annual Meeting

September 12–15, 2014  
Houston, Texas, USA

## Meet-the-Professor Sessions

## 미국 골대사 학회

Monday, September 15 11:30 am – 12:30 pm

Topic	Speaker	Type
What are Mesenchymal Stem Cells?	Pamela Robey, Ph.D., National Institute of Dental and Craniofacial Research (USA)	Basic
The NIH Geroscience Summit	Robert Jilka, Ph.D., University of Arkansas for Medical Sciences (USA) Joan McGowan, Ph.D., National Institute of Arthritis, Musculoskeletal & Skin Disease (USA) John Williams, Ph.D., National Institute on Aging (USA)	Translational
Cortical Bone Modeling (and Remodeling)	Ego Seeman, M.D., FRACP, Austin Health, University of Melbourne (Australia)	Translational
Diet and the Microbiome	Connie Weaver, Ph.D., Purdue University (USA)	Translational
Using Large Databases for Osteoporosis Research	Jeffrey Curtis, M.D., MPH, University of Alabama at Birmingham (USA)	Clinical
Management of Atypical Femoral Fractures	Angela Cheung, M.D., Ph.D., University Health Network-University of Toronto (Canada)	Clinical

# Big Data Dimensions

## Volume



Data at scale

Terabytes to petabytes of data

## Variety



Data in many forms

Structured, unstructured, text, multimedia

## Velocity



Data in motion

Analysis of streaming data to enable decisions within fractions of a second

## Veracity



Data uncertainty

Managing the reliability and predictability of inherently imprecise data types

# Big Meal?



Volume

Variety

# Velocity



© Gaetan Bally/Keystone/Corbis

## Potential Use Cases for Big Data Analytics

Real time

Credit & Market Risk in Banks

(중환자실 심전도)

Fraud Detection (Credit Card) & Financial Crimes (AML) in Banks  
(including Social Network Analysis)

Event-based Marketing in Financial Services and Telecoms

Markdown Optimization in Retail

Claims and Tax Fraud in Public Sector

Data Velocity

Predictive Maintenance in Aerospace

Social Media Sentiment Analysis

Demand Forecasting in Manufacturing

Disease Analysis on Electronic Health Records

Batch

Traditional Data Warehousing

Text Mining

Video Surveillance/Analysis

Structured

Semi-structured

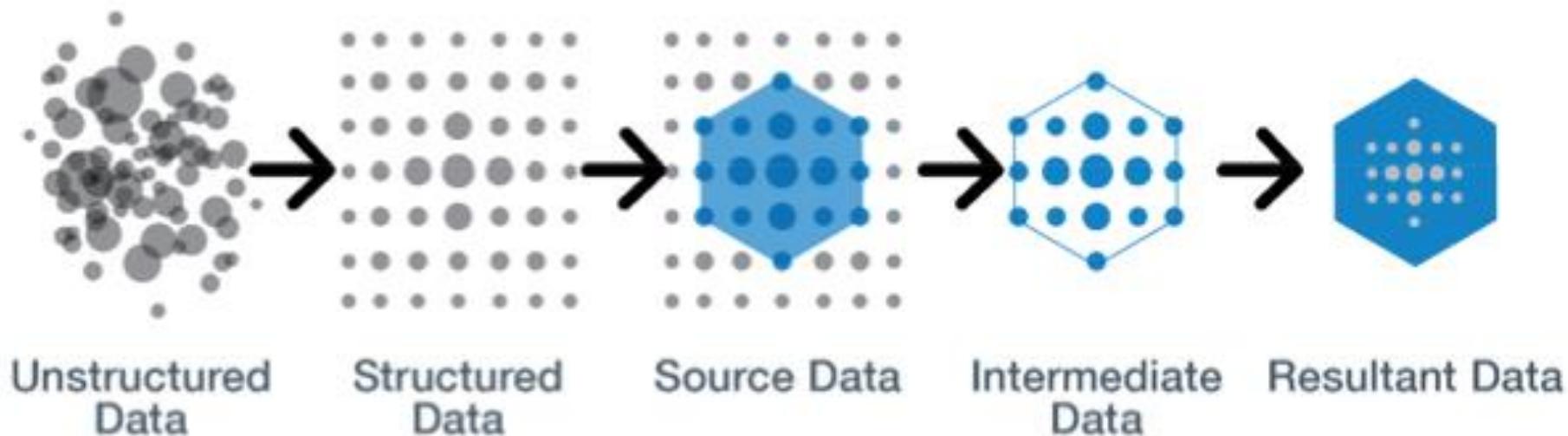
Unstructured

Data Variety

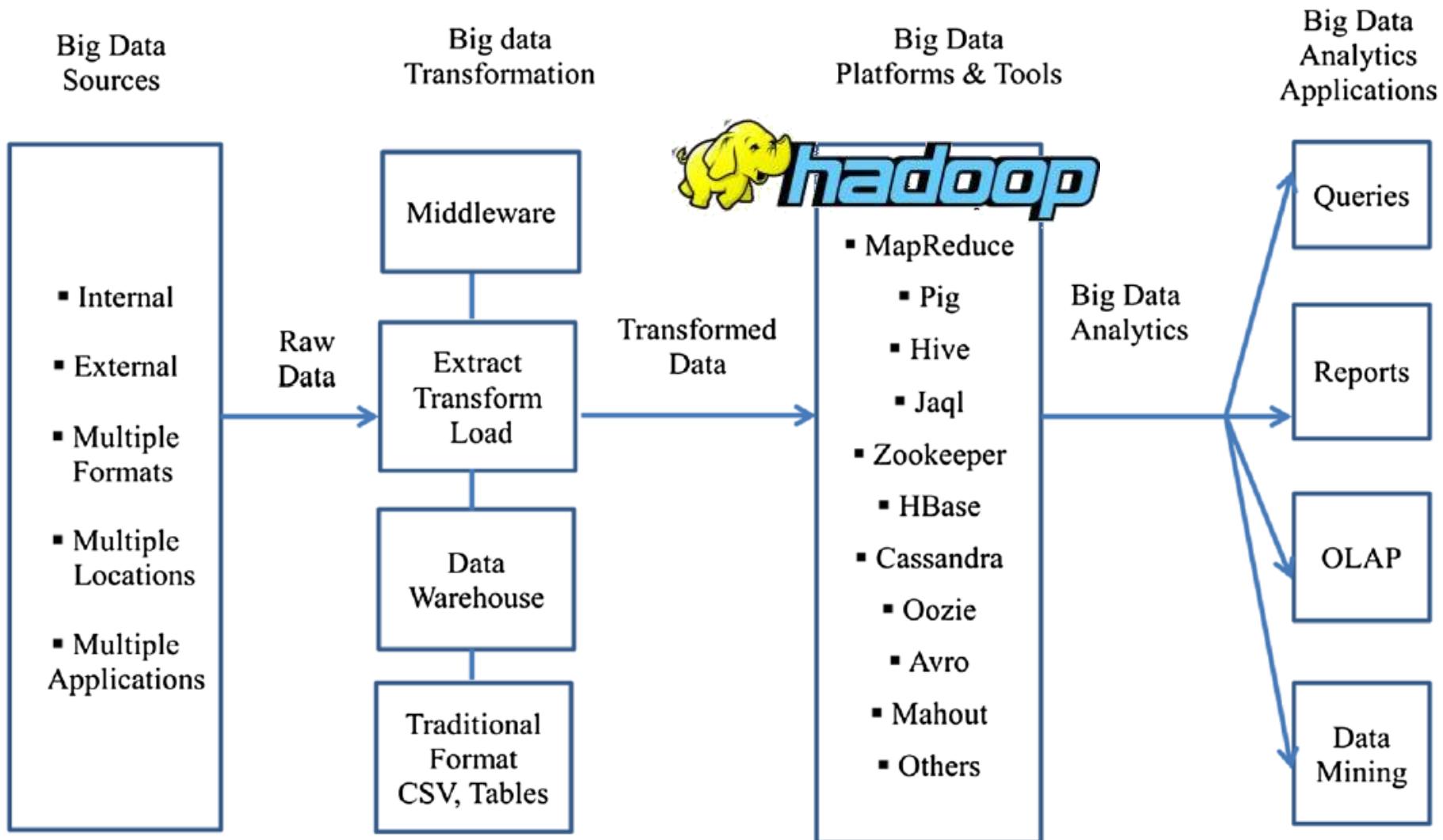
출처 : SAS and IDC

# Data Variety

## UNSTRUCTURED DATA TO RESULTS

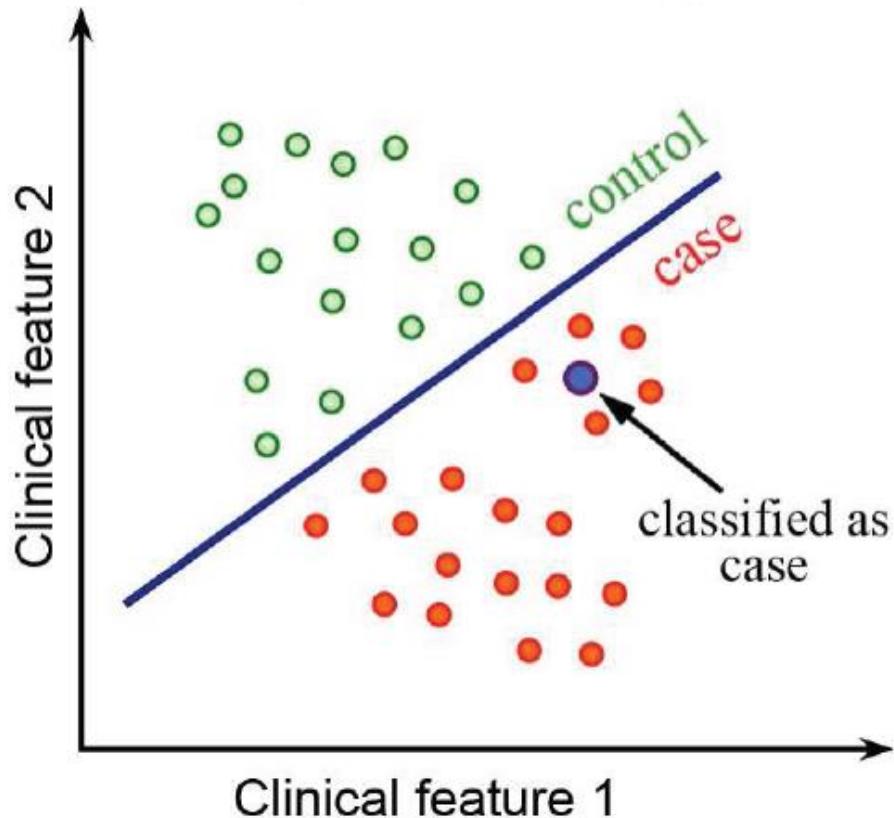


# Architecture of Big Data Analytics

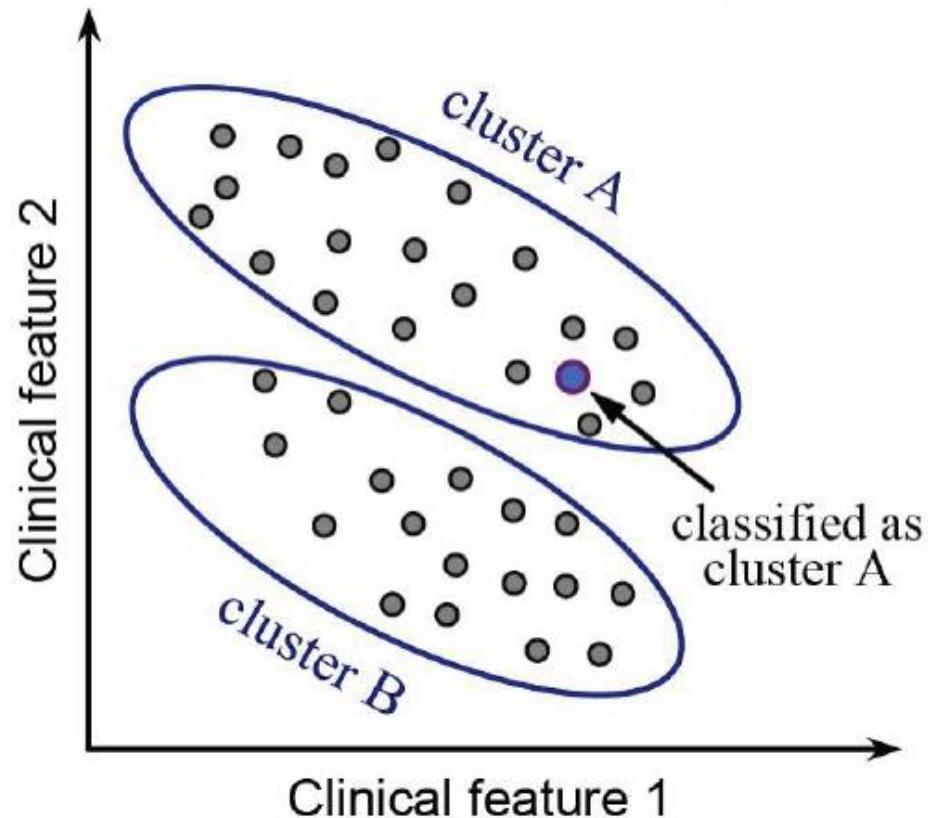


# Machine Learning

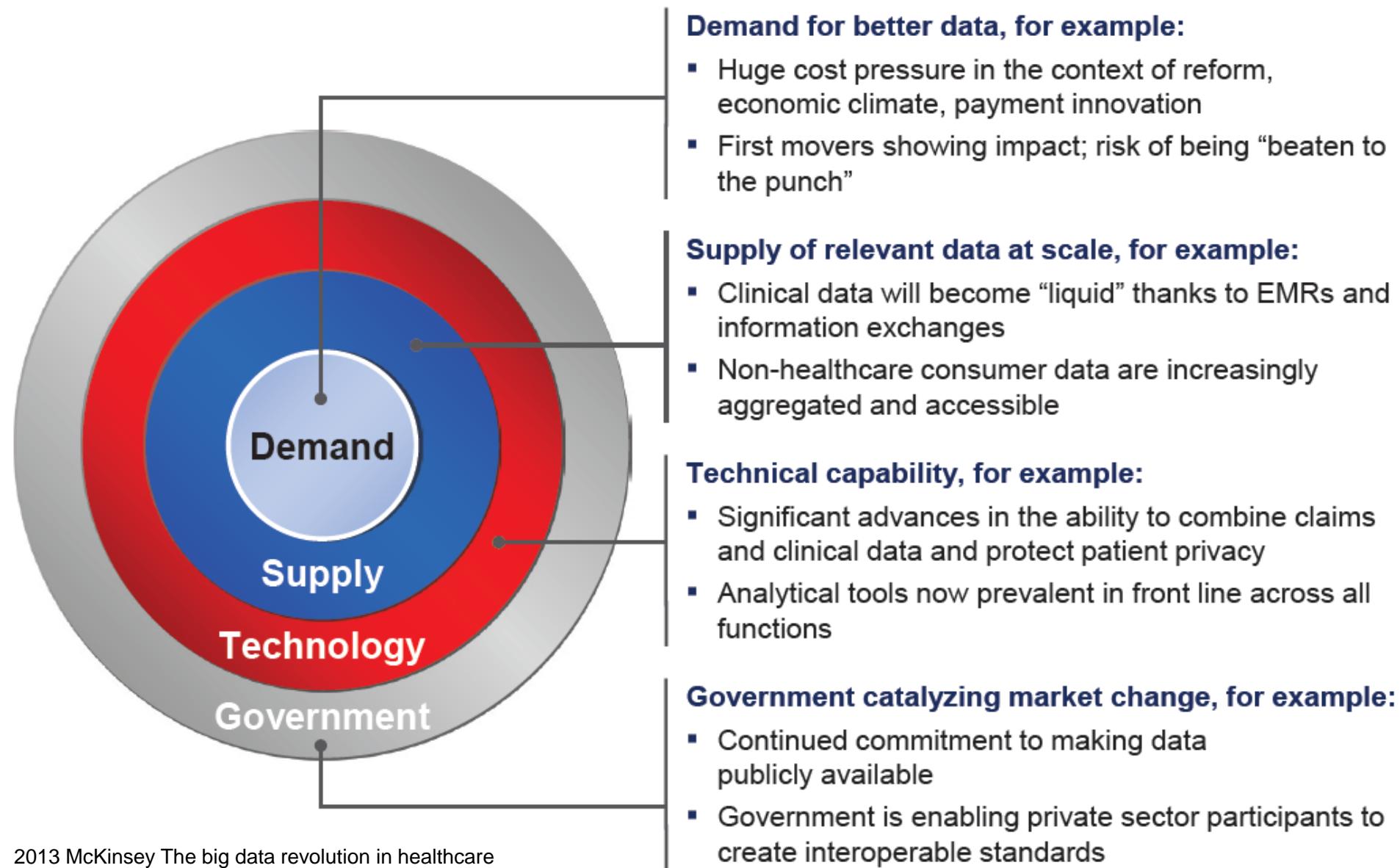
Supervised learning



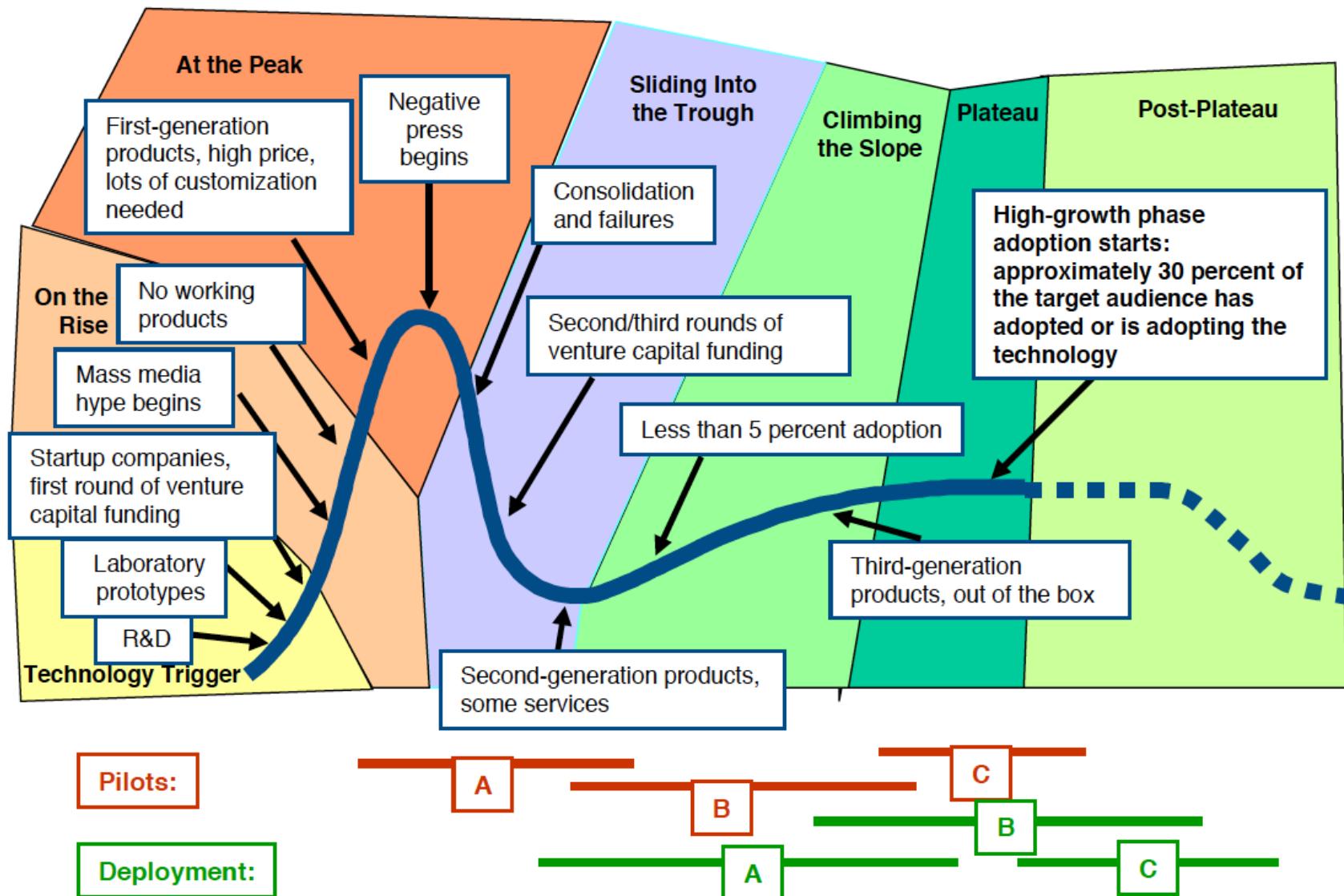
Unsupervised learning



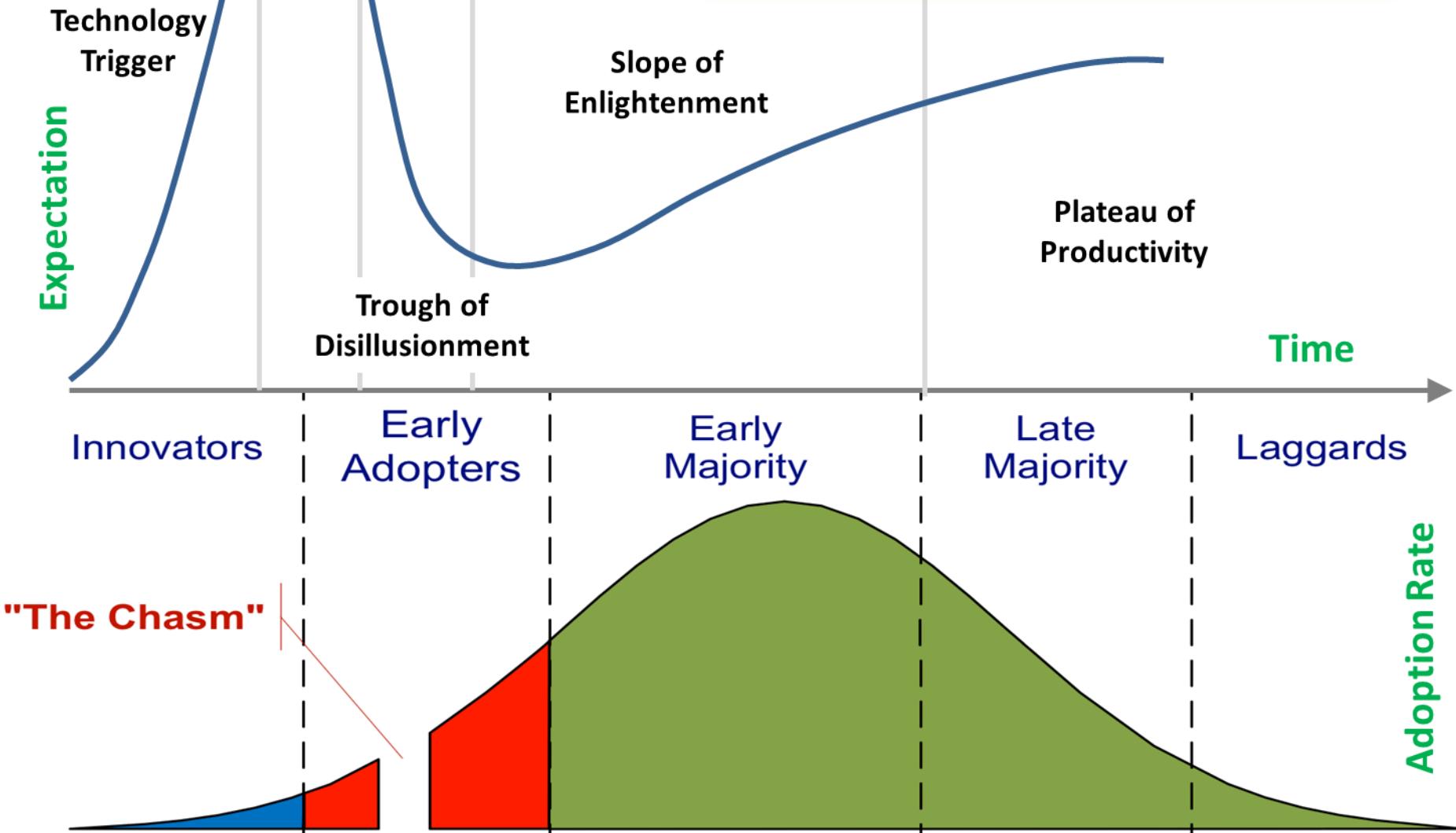
# Tipping Point for Big Data Healthcare

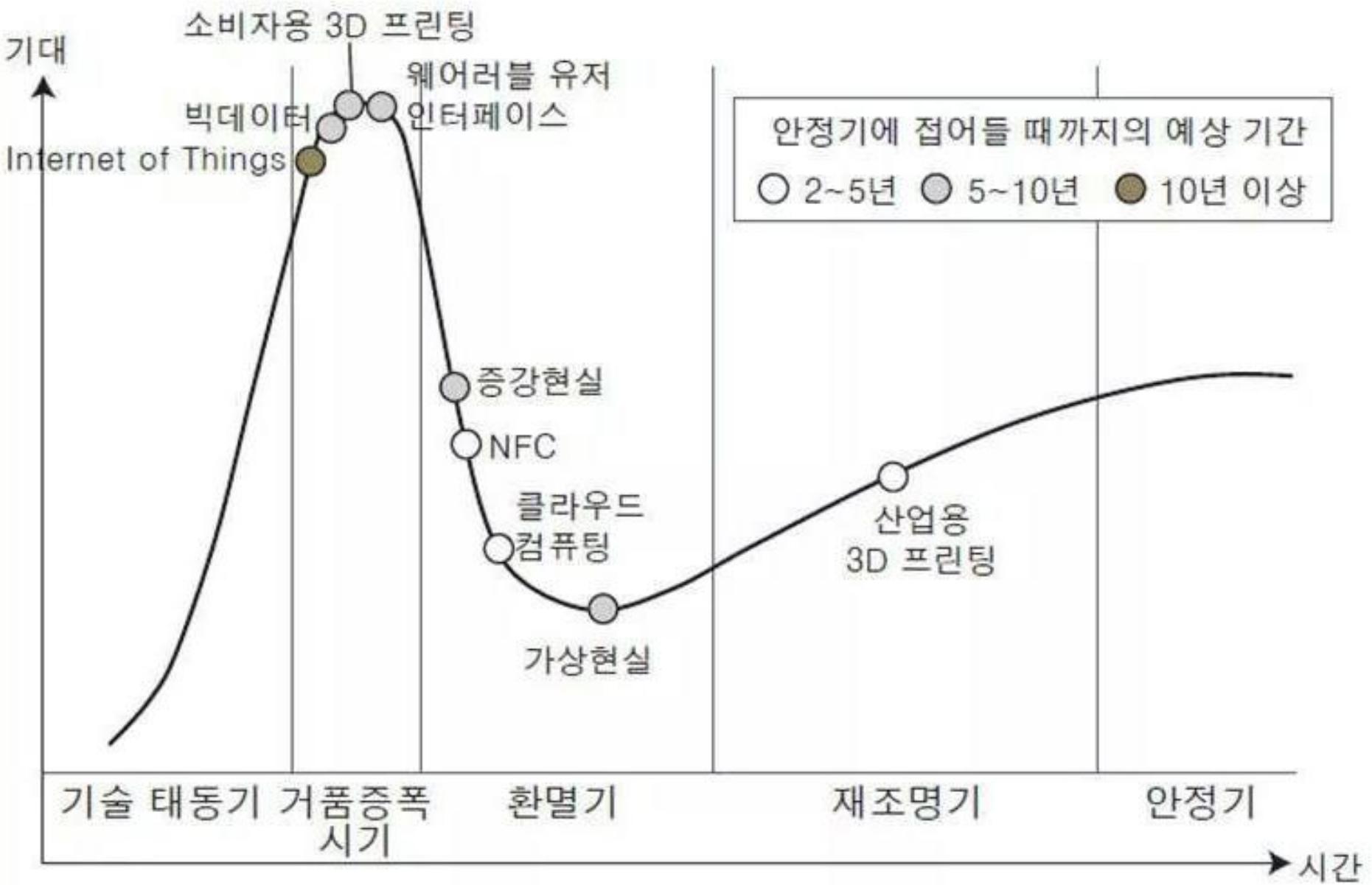


# Gartner's Hype Cycles



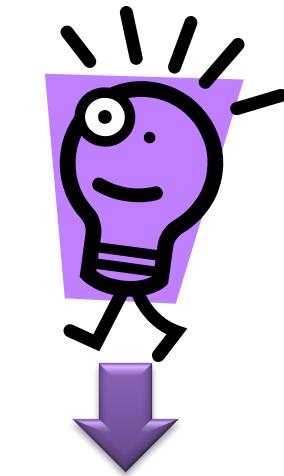
## Hype Cycle and Technology Adoption Lifecycle Plotted together





자료 : 가트너(2013년 7월)

# Hypothesis Driven Science   Data Driven Science



Hypothesis



Collect  
Data



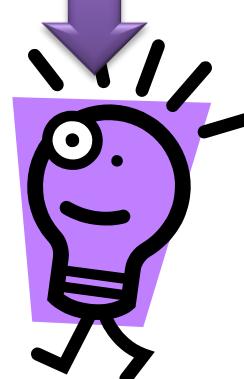
Analyze



Data

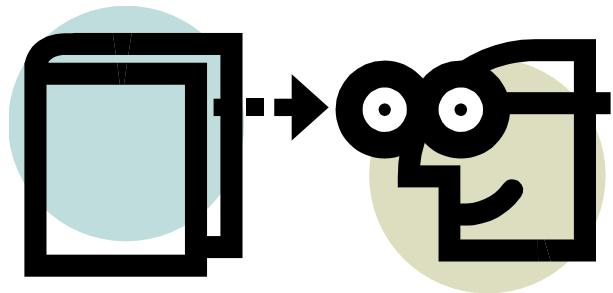


Analyze

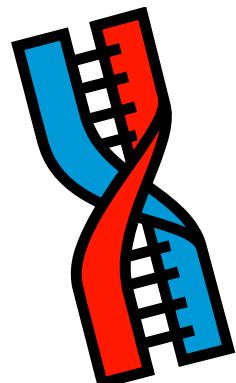


Generate  
Hypothesis

# Candidate Gene Approach

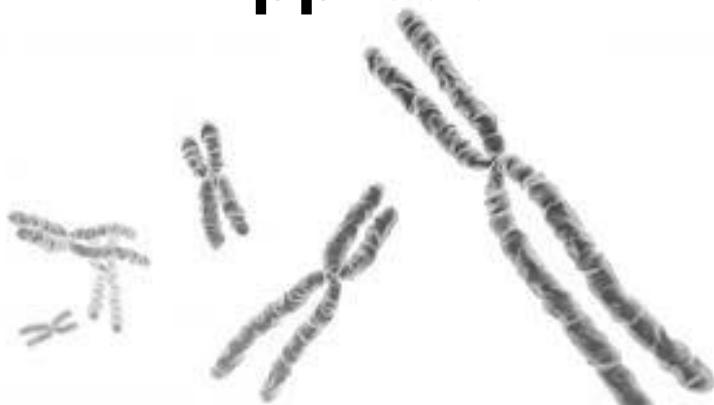


Choose a Gene  
from Prior Knowledge

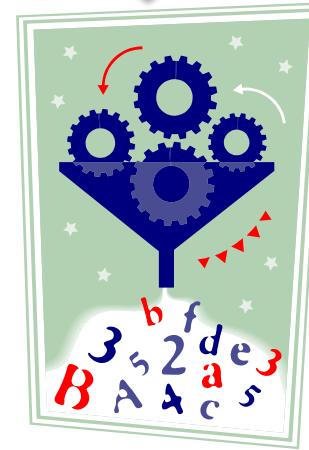


Analyze the Gene

# Genome-wide Approach



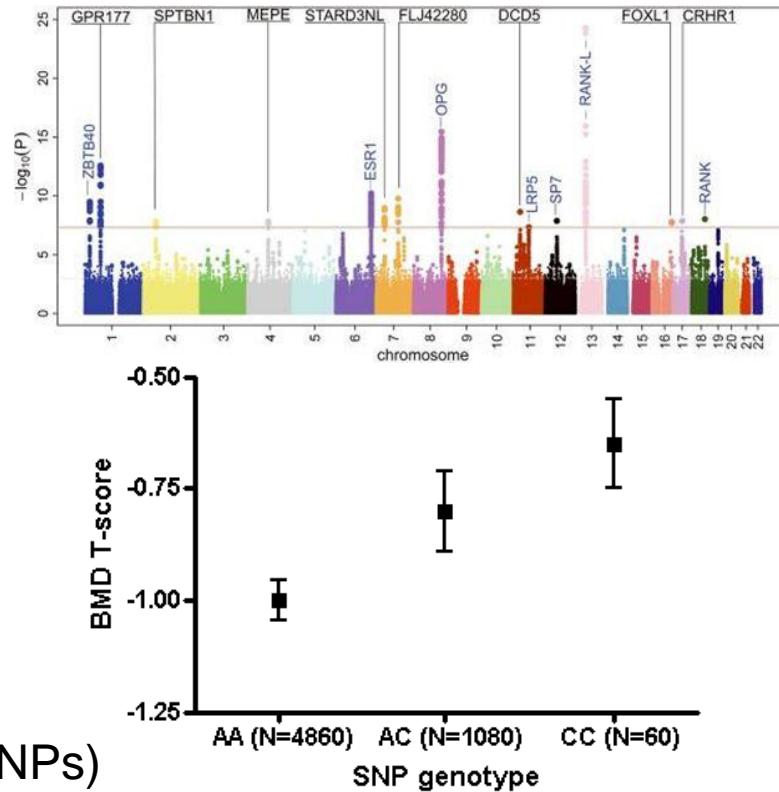
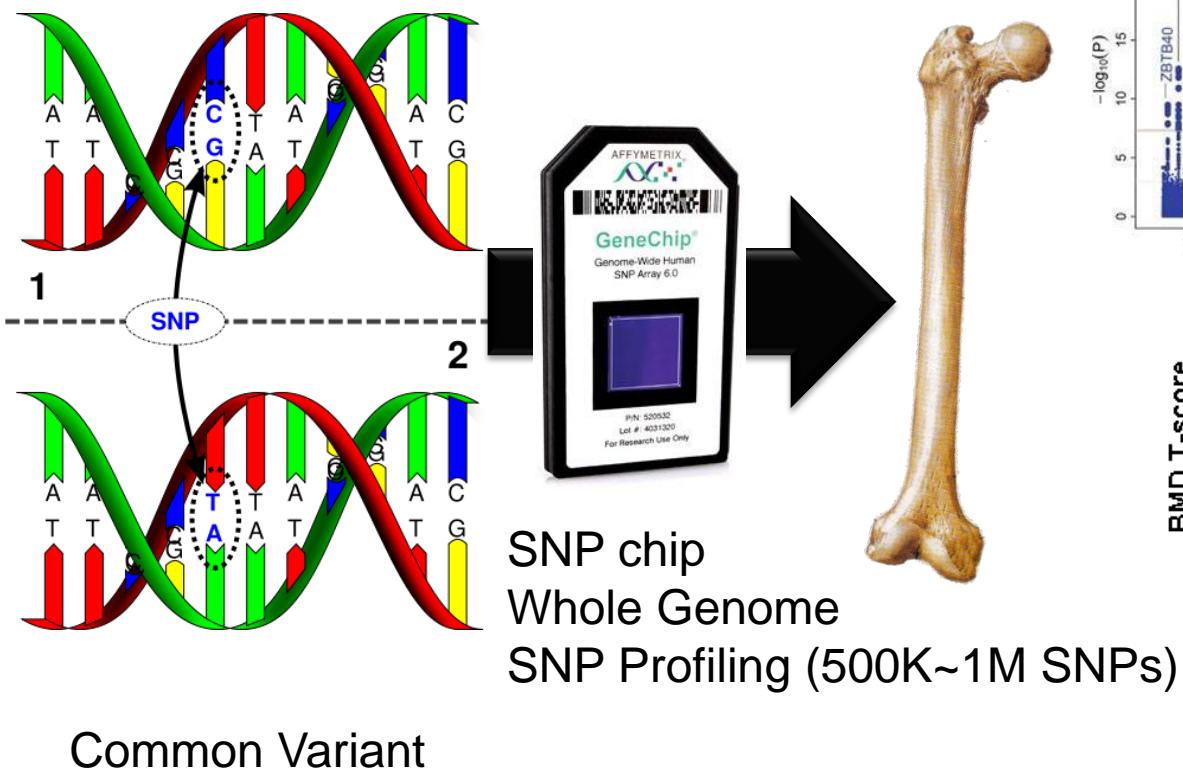
Analyze ALL Genes



Discover Novel Findings

# GWAS

## (Genome wide association study)



# Recent largest GWAS GEFOS consortium

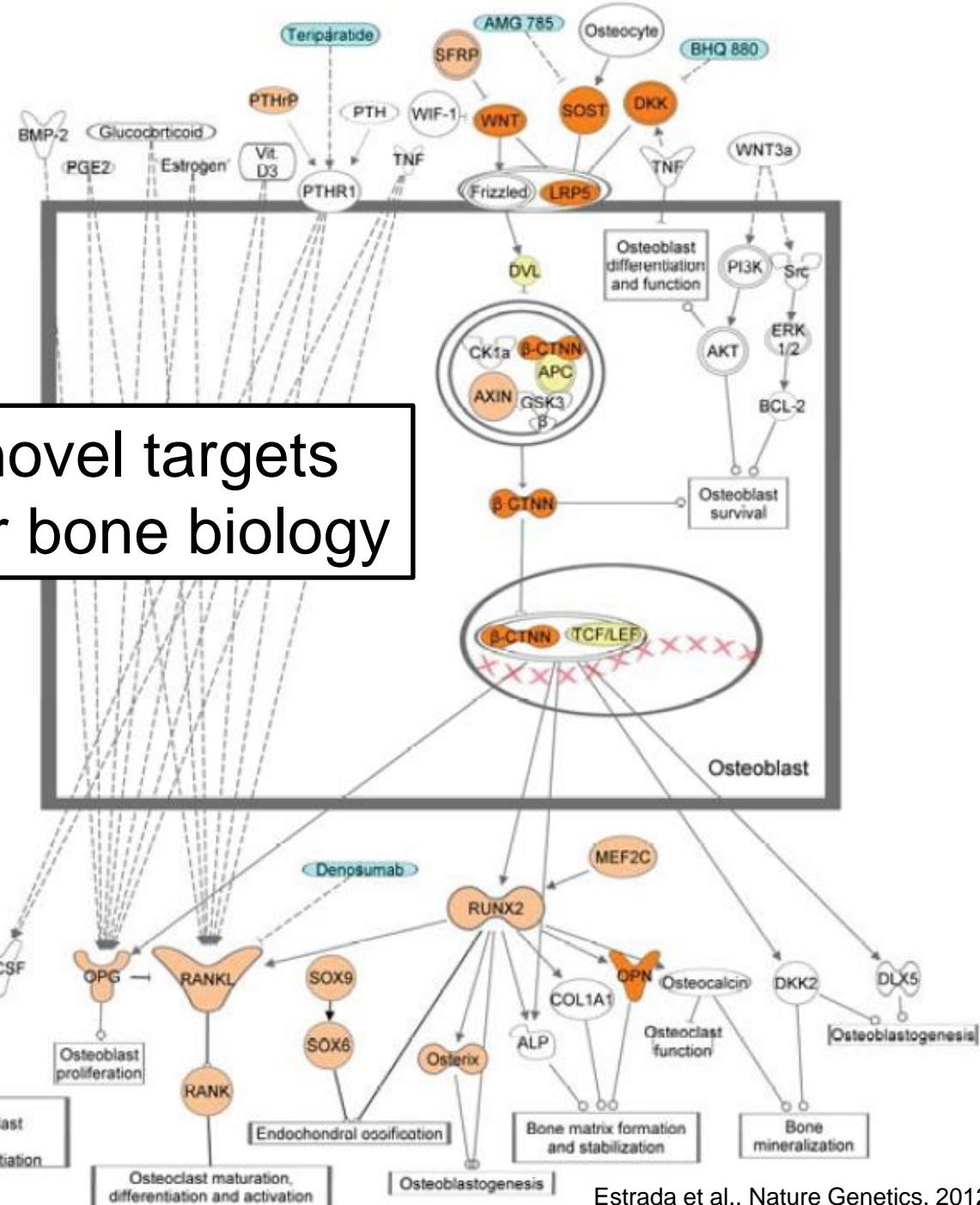


BMD discovery (stage 1)  
meta-analysis of 17 BMD genome-wide association studies  
( $n = 32,961$ )

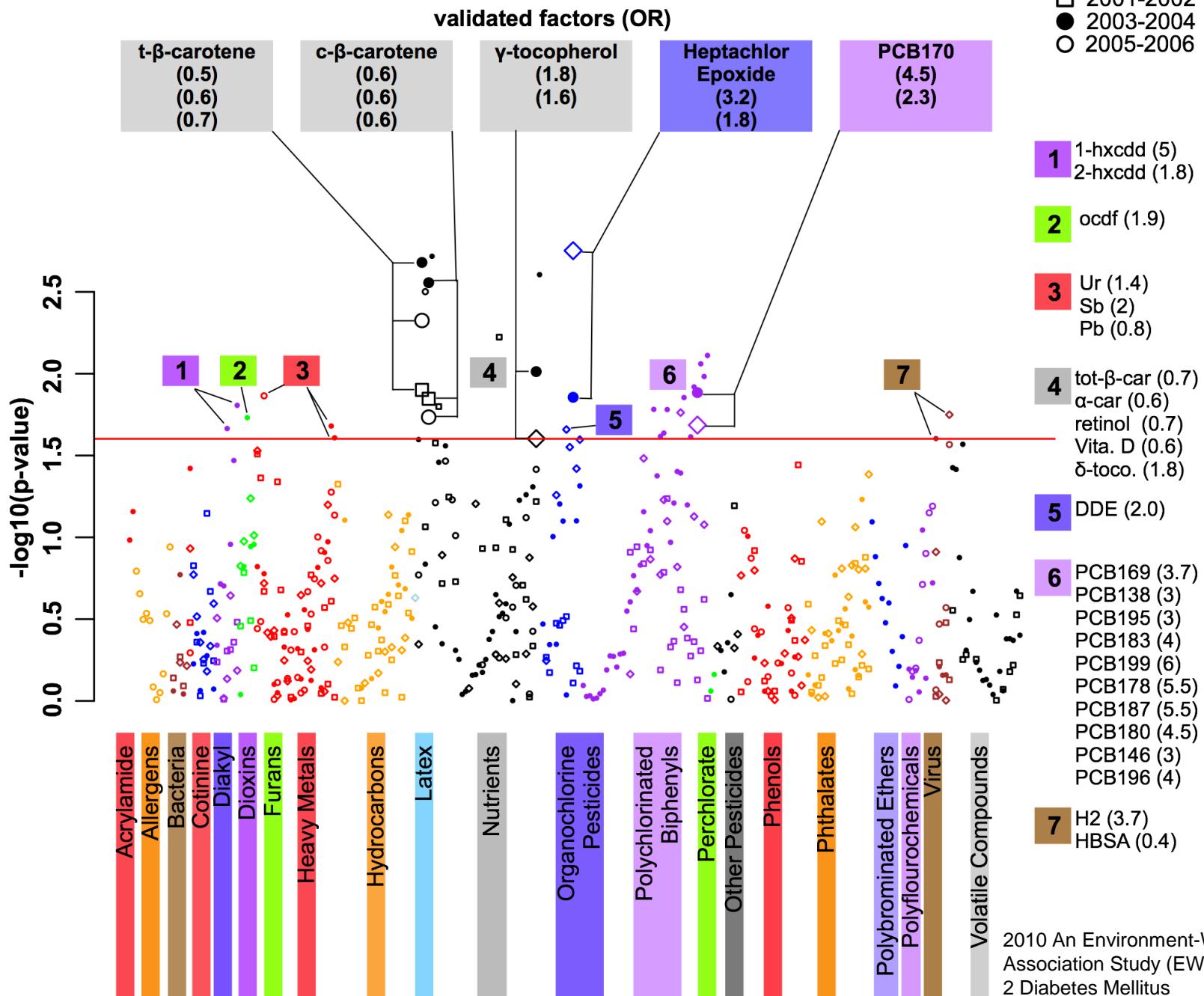
BMD replication (stage 2)  
96 SNPs in 34 studies  
(*de novo* and *in silico*)  
( $n = 50,933$ )

Association of the BMD loci with fracture (stage 3)  
96 SNPs in 50 studies  
(*de novo* and *in silico*)  
( $n = 31,016$  cases and 102,444 controls)

+ novel targets  
for bone biology



# Environment-Wide Association Study (EWAS)



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Courtesy of Corven Networks

# Genomics



## Medical Informatics

Electronic Medical Records (EMR)

Medical Images (MRI, CT)

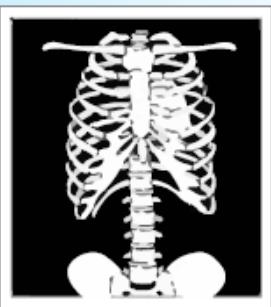
National Healthcare data (Insurance)

## Health Avatar

## Quantified Self



## Wearable/ Smart Device



X-RAY 30MB



**0.5MB**  
is generated

**It is estimated that by 2015, the average hospital will generate**

**665TB**

## **Access to electronic patient data beyond the desktop**



A blue silhouette of a human torso and head is centered against a background of binary code (0s and 1s). The silhouette is oriented vertically, with the head at the top and the torso below it. The background consists of a grid of binary digits, creating a digital or technological feel.



3D MRI 150MB

MAMMOGRAMS  
**120MB**



**3D CT SCAN 1GB**



There are currently  
**425K**  
telehealth providers in the U.S.<sup>2</sup>

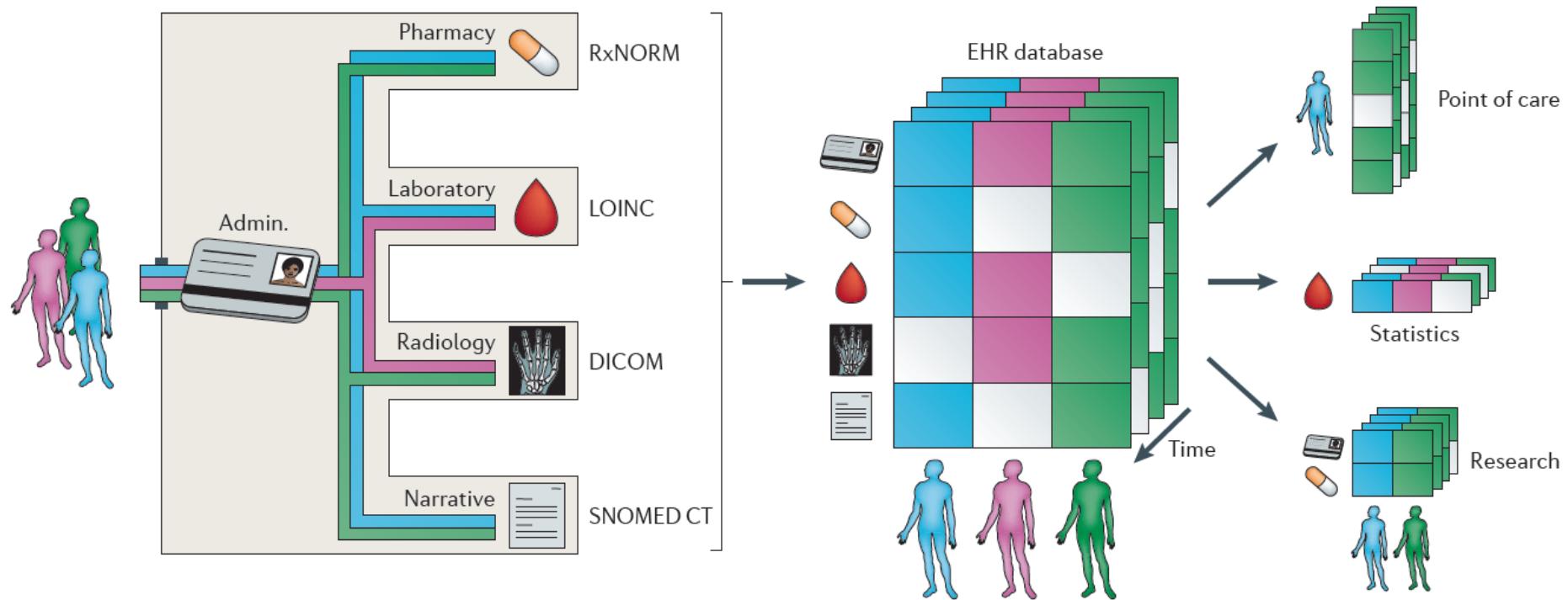
# Contents

1. What is Big Data?
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3. Clinical and Research Applications



Courtesy of Corven Networks

# Electronic Health Records



# Common EHR Data

	ICD	CPT	Lab	Medication	Clinical notes
Availability	High	High	High	Medium	Medium
Recall	Medium	Poor	Medium	Inpatient: High Outpatient: Variable	Medium
Precision	Medium	High	High	Inpatient: High Outpatient: Variable	Medium high
Format	Structured	Structured	Mostly structured	Structured and unstructured	Unstructured
Pros	Easy to work with, a good approximation of disease status	Easy to work with, high precision	High data validity	High data validity	More details about doctors' thoughts
Cons	Disease code often used for screening, therefore disease might not be there	Missing data	Data normalization and ranges	Prescribed not necessary taken	Difficult to process

International Classification of Diseases (ICD)  
Current Procedural Terminology (CPT)

# Medication Data

# Lab Data

종료 진단검사의학 핵의학체외 핵의학체내 영상의학 병리검사 특수검사 영양검색 검사별처방목록 Lab출력

**처방일별  
진료과별**

처방일자 **2014-02-26** 병록번호 [REDACTED]  
 접수일자 성별/나이 M/55 접수일자 2014-03-24  
 담당의사 접수시간 09:06:36 시계열 조회

**총료 [X]** **Refresh**

기간별  1년간  한달간 2013-03-26 ~ 2014-03-26 일반검사  접수 시간 **결과조회** **항목선택** **출력** **Exit**

검사명	참고치	14-03-24	14-02-24	14-02-03	14-01-21	14-01-13	14-01-06	13-12-30	13-12-30	13-12-24	13-12-20
22 CBC/WBC count	4.0~10.0	4.71	▼3.78	4.93	4.80	4.78	6.37	6.74		6.84	9.72
23 RBC count	M:4.2~6.3,F: 4.37		▼4.01	▼3.83	▼3.28	▼3.15	▼3.18	▼3.19		▼3.59	▼3.05
24 Hb	M:13~17,F:12	▼12.9	▼12.3	▼11.8	▼10.3	▼9.7	▼9.8	▼10.0		▼11.4	▼9.6
25 Hct	M:39~52,F:36~39.2		▼36.6	▼35.3	▼30.1	▼28.7	▼28.8	▼29.2		▼32.4	▼27.7
26 PL								172		196	179
27 ESR								▲13		▲25	
28 se								72.2		71.0	90.7
29 Ly								▼14.8		▼17.4	▼5.1
30 Mo								▲11.7		9.9	4.1
31 Eo								1.2		1.6	0.1
32 Ba								0.1		0.1	0.0
33 RD								▲15.9		▲15.9	▲16.3
34 PD								▼12.2		▼11.9	▼11.6
35 Chen											
36 Elect											
37 Ca											
38 Glu											
39 Cr											
40 eG											
41 Ur											
42 Ch											
43 Pr											
44 Alb											
45 AS											
46 AL											
47 Alk											
48 Bill											
49 Ph											
50 BUN	8.0~20.0	▲22.9	19.7					1.6		20.0	20.0
51 Sodium	135~145	141	145					40		127	142

**HbA1c-NGSP**

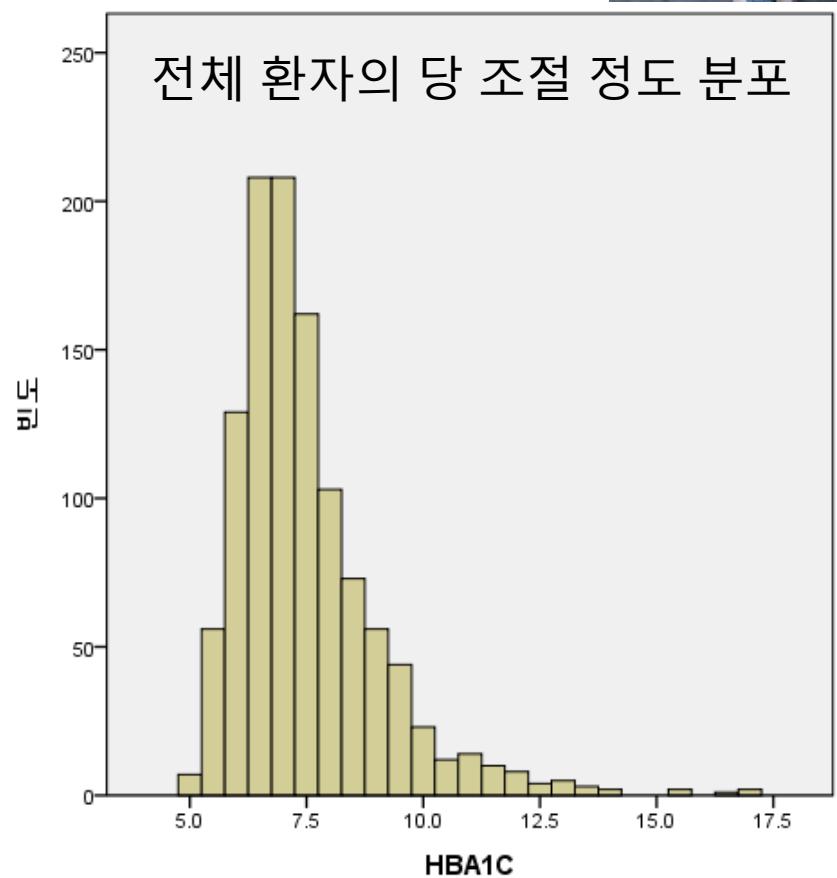
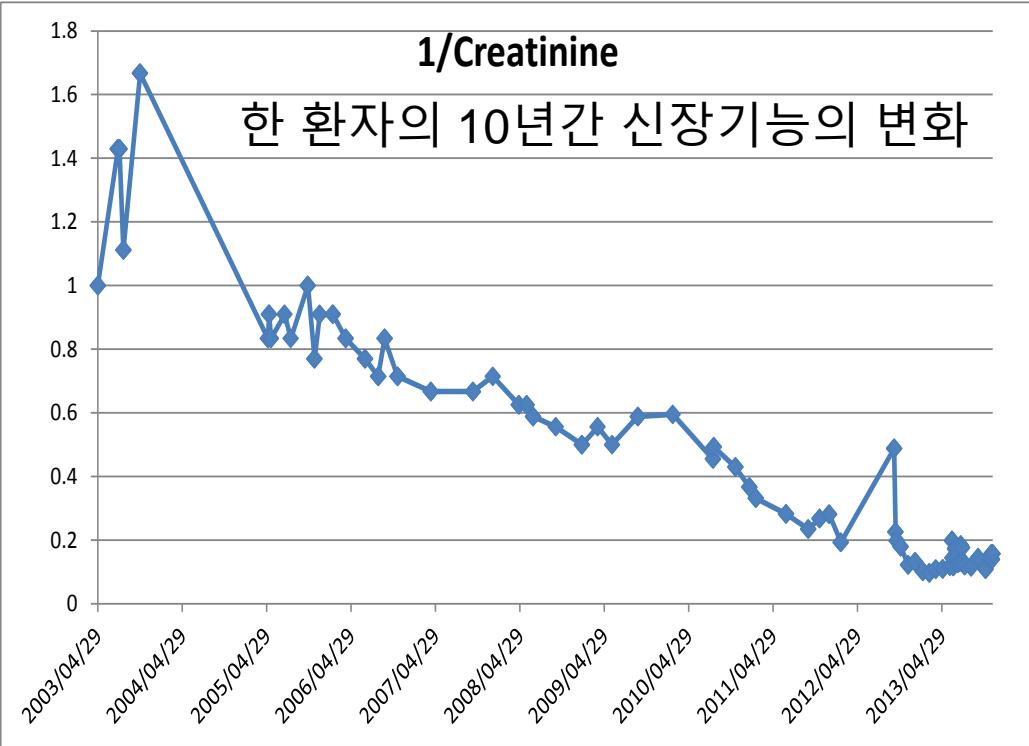
결과값

검사일

	A	B	C	D	E	F	G	H	I	J
1	PTNO	SNAME	SEX	AGE	JUPSUPDATE	ORDERCC	CODENAME	SUBCODE	SUBCODE	RDATA
2	012	윤	M	50	1998-11-06	NK8001	CBC(Em)	NK8011	WBC	6.4
3	012	윤	M	50	1998-11-06	NK8001	CBC(Em)	NK8013	Hb	13.8
4	012	윤	M	50	1998-11-06	NK8001	CBC(Em)	NK8015	Platelet	361
5	012	윤	M	50	1998-11-06	NK8101	Electrolyte	NK8130	Sodium	150
6	012	윤	M	50	1998-11-06	NK8101	Electrolyte	NK8131	Potassium	4.0
7	012	윤	M	50	1998-11-06	NK8101	Electrolyte	NK8132	Chloride	113
8	012	윤	M	50	1998-11-06	NK8101	Electrolyte	NK8133	Co2, Total	23
9	012	윤	M	50	1998-11-06	NK8142	Glucose	NK8142	Glucose	158
10	012	윤	M	50	1998-11-06	NK8143	Creatinine	NK8143	Creatinine	0.9
11	012	윤	M	50	1998-11-06	NK8144	BUN	NK8144	BUN	17
12	012	윤	M	50	1998-11-06	NK8146	AST	NK8146	AST	40
13	012	윤	M	50	1998-11-06	NK8147	ALT	NK8147	ALT	62
14	009	권	M	60	1999-03-26	NK3003	Electrolyte	NK3041	Sodium	143
15	009	권	M	60	1999-03-26	NK3003	Electrolyte	NK3041	Sodium	143
16	009	권	M	60	1999-03-26	NK3003	Electrolyte	NK3042	Potassium	5.3
17	009	권	M	60	1999-03-26	NK3003	Electrolyte	NK3042	Potassium	5.3
18	009	권	M	60	1999-03-26	NK3003	Electrolyte	NK3043	Chloride	108
19	009	권	M	60	1999-03-26	NK3003	Electrolyte	NK3043	Chloride	108
20	009	권	M	60	1999-03-26	NK3003	Electrolyte	NK3044	Total CO2	21
21	009	권	M	60	1999-03-26	NK3003	Electrolyte	NK3044	Total CO2	21
22	022	김	F	65	1999-06-01	NK3231	HbA1c	NK3231	HbA1c	6.14 %
23	022	김	F	65	1999-06-01	NK3231	HbA1c	NK3231	HbA1c	6.14 %
24	002	송	M	64	1999-06-02	NK3004	Lipid Batter	NK3015	Cholesterol	218
25	002	송	M	64	1999-06-02	NK3004	Lipid Batter	NK3081	Triglycerid	215

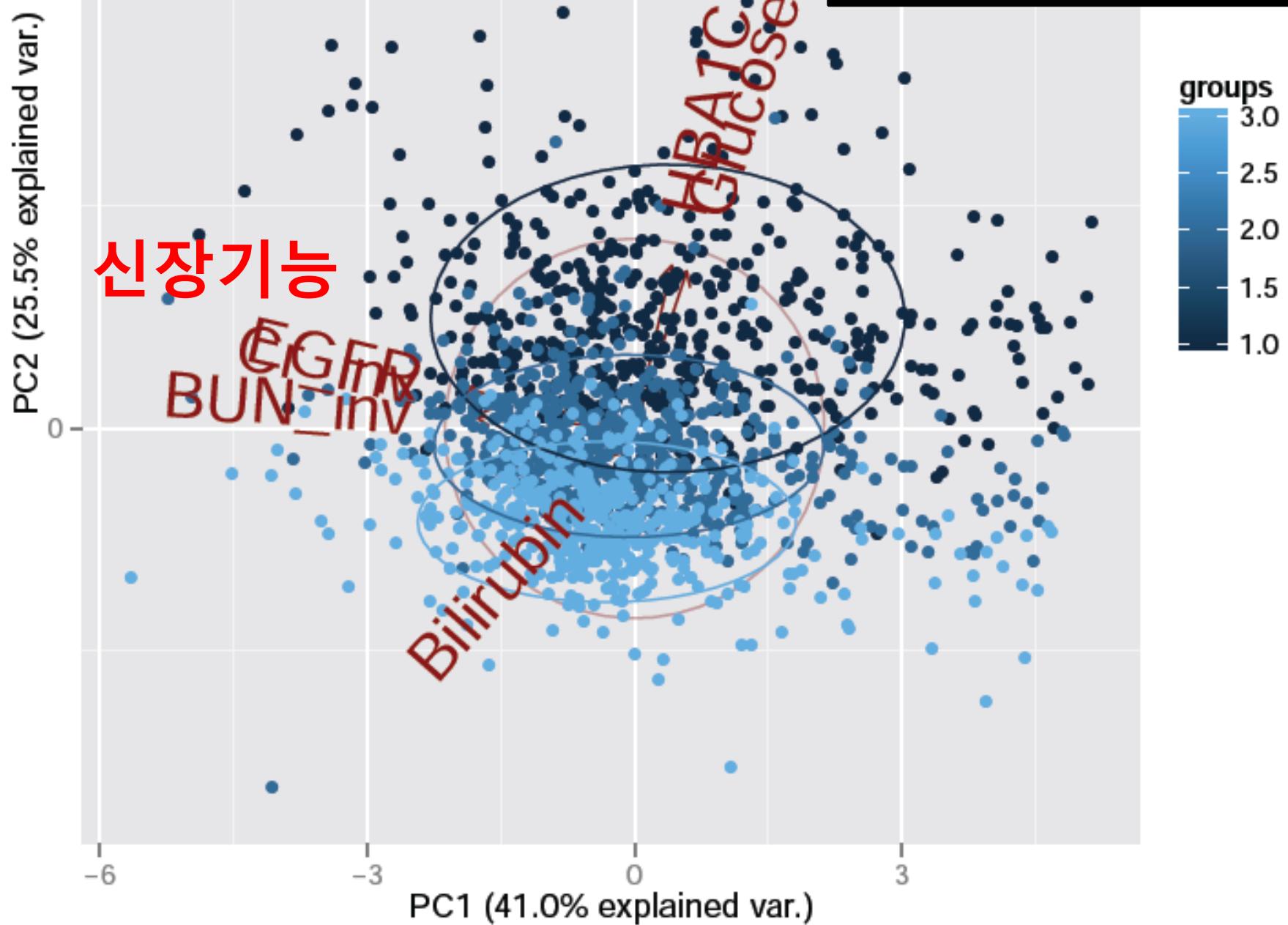
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1048551	061	최	M	55	2014-02-11	NK312360	Micro Alb	NK312360	A/C ratio	17.3
1048552	061	최	M	55	2014-02-11	NK312360	Micro Alb	NK312360	Micro Alb	36.6
1048553	061	최	M	55	2014-02-11	NK312360	Micro Alb	NK312360	Creatinine	211.6
1048554	061	최	M	55	2014-02-11	NK3231	HbA1c	NK3231	HbA1c-NC	7.6
1048555	061	최	M	55	2014-02-11	NK3231	HbA1c	NK3231	HbA1c-NC	7.6
1048556	066	반	M	53	2014-02-11	NK3011	Calcium	NK3011	Calcium	9.2
1048557	066	반	M	53	2014-02-11	NK3014	Uric Acid	NK3014	Uric acid	7.2
1048558	066	반	M	53	2014-02-11	NK3031	Phosphorus	NK3031	Phosphorus	3.8
1048559	066	반	M	53	2014-02-11	NK8000	응급 검사:	NK8000 32	PLT. clumps	
1048560	066	반	M	53	2014-02-11	NK8000	응급 검사:	NK8001 19	NE%	61.0
1048561	066	반	M	53	2014-02-11	NK8000	응급 검사:	NK8011	WBC count	7.63
1048562	066	반	M	53	2014-02-11	NK8000	응급 검사:	NK8013	Hb	10.4
1048563	066	반	M	53	2014-02-11	NK8000	응급 검사:	NK8015	PLT count	152
1048564	066	반	M	53	2014-02-11	NK8101	응급 검사:	NK8130	Sodium,EM	134
1048565	066	반	M	53	2014-02-11	NK8101	응급 검사:	NK8131	Potassium	5.3
1048566	066	반	M	53	2014-02-11	NK8101	응급 검사:	NK8132	Chloride,EM	104
1048567	066	반	M	53	2014-02-11	NK8101	응급 검사:	NK8133	Total CO2	18
1048568	066	반	M	53	2014-02-11	NK8172	응급 검사:	NK8142	Glucose,EM	169
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1048570	066	반	M	53	2014-02-11	NK8172	응급 검사:	NK81431	eGFR	24.5
1048571	066	반	M	53	2014-02-11	NK8172	응급 검사:	NK8144	BUN,EM	34.6
1048572	066	반	M	53	2014-02-11	NK8172	응급 검사:	NK8145	Protein,EM	7.0
1048573	066	반	M	53	2014-02-11	NK8172	응급 검사:	NK8146	AST,EM	13
1048574	066	반	M	53	2014-02-11	NK8172	응급 검사:	NK8147	ALT,EM	9
1048575	066	반	M	53	2014-02-11	NK8172	응급 검사:	NK8156	Albumin,EM	4.4
1048576	066	반	M	53	2014-02-11	NK8172	응급 검사:	NK8170	Bilirubin t	0.38

# Big Data Analysis



혈당

# PCA Analysis





환자메모 07507627 F/47.6 [재진][2014-06-11] HD: (-) POD:

**환자메모**

기록조회 기록작성

**외래 재진기록지-IM-기본 [내과]**

등록번호: 0 [REDACTED] 성명: [REDACTED] 성별: 여 나이: 47  
작성일자: 2014-06-11 09:19 진료과: 내분비대사(내과)

**Subjective**  
약 잘 복용한다.  
Graves

약 잊은 날이 하루 있다.

**Objective**  
T3 S.B 111 78-182  
Free T4 S.B 1.20 0.89-1.79  
TSH S.B ▼0.09 0.17-4.05  
TSH-R-Ab(TBII) S.B 4.2 1.00(+) : Negative

**추정진단(Assessment)**  
갑상선 발증 또는 급성 발작을 동반하지 않은 미만성 고이터를 동반한 갑상선독증

**계획(Plan)**  
유지 (2013.12.31. 시작)

# 간호기록지

# Word Cloud

밤동안 저혈당수면 Lt.foot rolling Keep 떨림, 식은땀, 현기증, 공복감, 두통, 피로감등의 저혈당에 저혈당이 있을을 즉알려주도록 밤사이 특이호소 수면유지상처와 통증 상처부위 출혈 oozing, severe pain 알리도록 고혈당 처방된 당뇨식이의 중요성과 간식을 자제하도록 고혈당,, 관리 방법 .당뇨약 이해 잘하고 수술부위 oozing Rt.foot rolling keep드레싱 상태를 고혈당 고혈당 의식변화 BST 387 checked. 고혈당으로 인한 구강 내 감염 위해 식후 양치, gargle 등 구강 위생 격려. 당뇨환자의 발관리 방법에 목표 혈당, 목표 당화혈색소에 .식사를 거르거나 지연하지 않도록 .식사요법, 운동요법, 약물요법을 정확히 지키는 것이 중요을 .처방된 당뇨식이의 중요성과 간식을 자제하도록 고혈당,, 관리 방법 .혈당 정상 범위임 rt foot rolling 중으로 pain호소 밤사이 수면양호걱정신경 예민감정변화 중임감정을 표현하도록 지지하고 경청기분상태 condition 조금 나은 듯 하다고 혈당 조절과 관련하여 신경쓰는 모습 보이며 혈당 self로 측정하는 모습 보임혈당 조절에 안내하고 불편감 지속알리도록 고혈당 고혈당 의식변화 고혈당 허약감 지남력 혈당조절 안됨고혈당으로 인한 구강 내 감염 위해 식후 양치, gargle 등 구강 위생 격려. 당뇨환자의 정기점검 내용과 빈도에 .BST 140 으로 저혈당 호소 밤동안 저혈당수면 Lt.foot rolling Keep 떨림, 식은땀, 현기증, 공복감, 두통, 피로감등의 저혈당에 저혈당이 있을을 즉알려주도록 pain 및 불편감 호소 WA 잘고혈당 고혈당 의식변화 고혈당 허약감 지남력 혈당조절 안됨식사요법, 운동요법 약물요법을 정확히 지키는 것이 중요을 .저혈당/고혈당과 대처법에 .혈당정상화, 표준체중의 유지, 정상 혈중지질의 유지에 .고혈당,, 관리 방법 .혈당측정법, 인슐린 자가 투여법, 경구투약, 수분 섭취량, 대체 탄수화물, 의료진의 도움이 필요한 사항에 교혈당 정상 범위임수술부위 oozing Rt.foot rolling keep수술 부위 (출혈, 통증, 부종)수술부위 출혈 상처부위 oozing Wound 당겨지지 않도록 적절한 체위 취하기 설명감염 발생 위험 요인 수술부위 출혈 밤동안 저현다 호스 수면 약사 약효 rt foot rolling 은지



# Natural Language Processing (NLP)





# Contents

## 1. What is Big Data? 2. Healthcare Big Data

### ① Electrical Health Records (EHR)

Structured/Unstructured Data

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### ③ National Healthcare Data

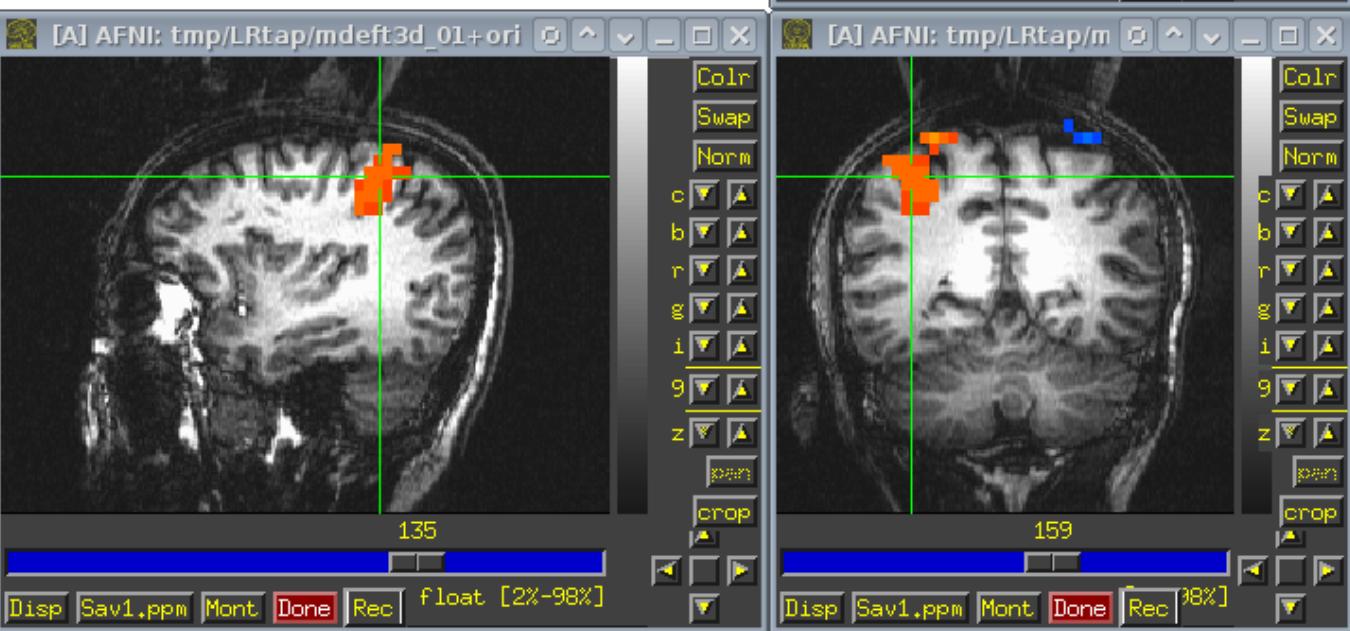
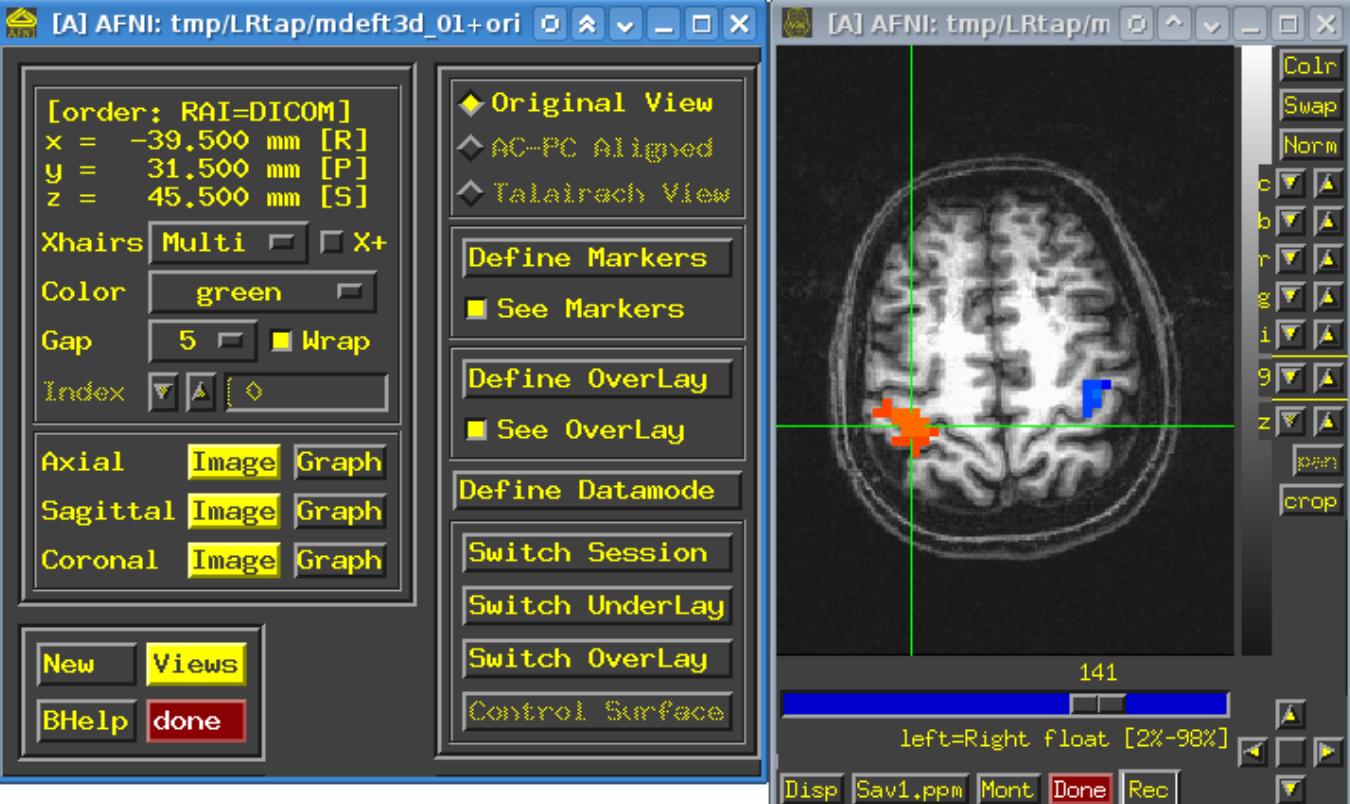
### ④ Behavior/Sensor Data

### ⑤ Genetic Data

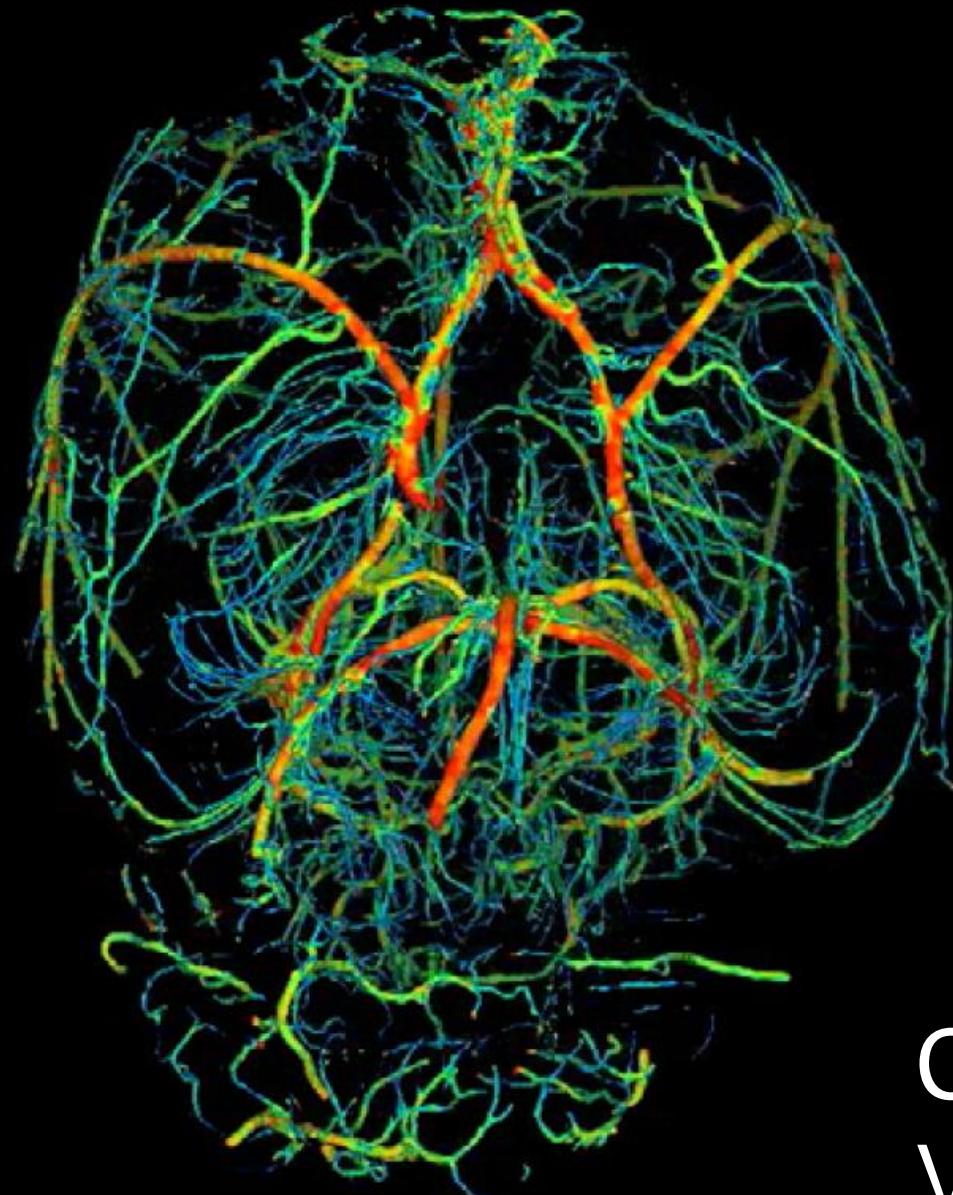
## 3. Clinical and Research Applications



# Medical Images



# Brain Vasculature



Color =  
Vessel Diameters



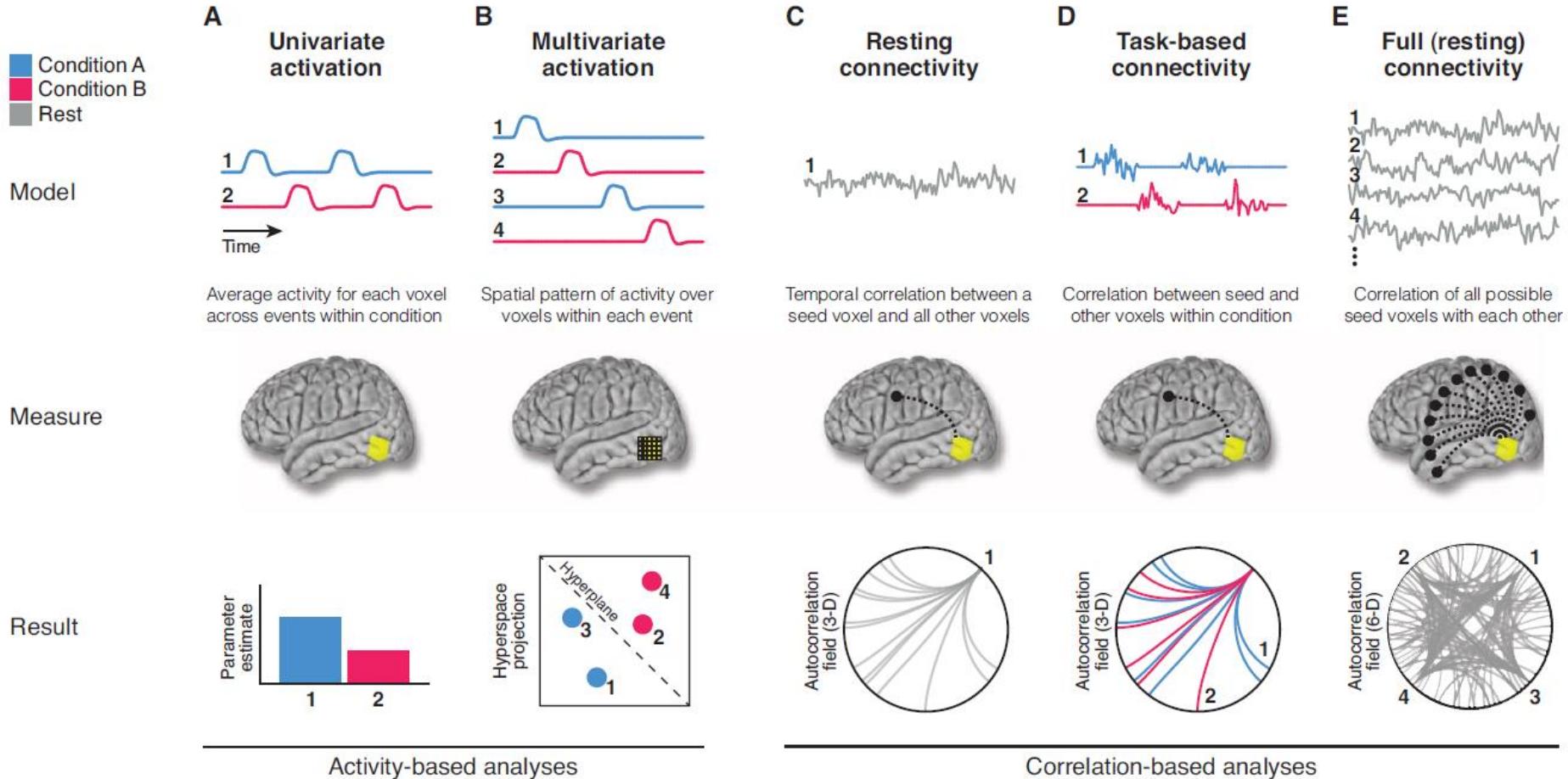
## The Heavily Connected Brain

REVIEW

# Functional Interactions as Big Data in the Human Brain

Nicholas B. Turk-Browne\*

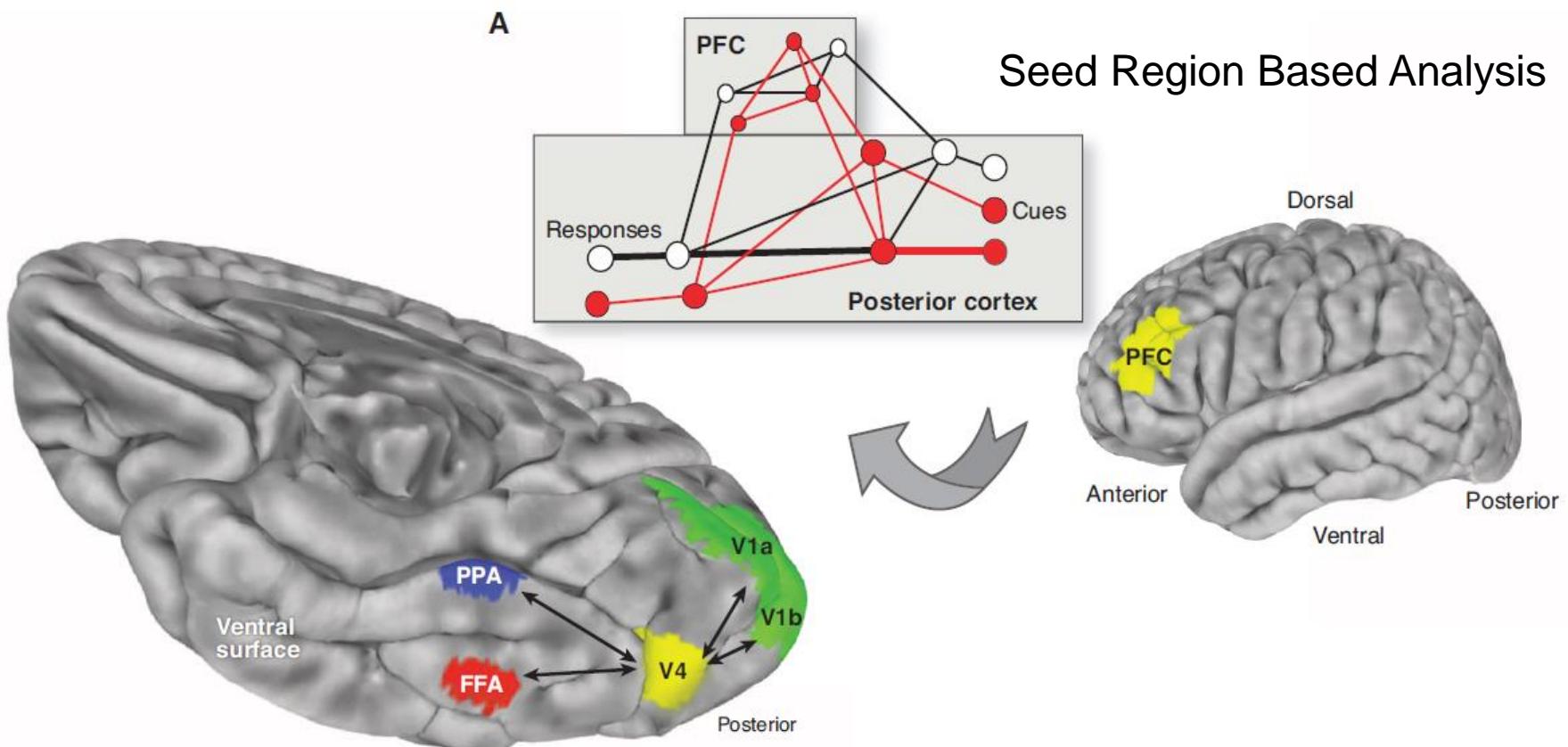
# fMRI analysis



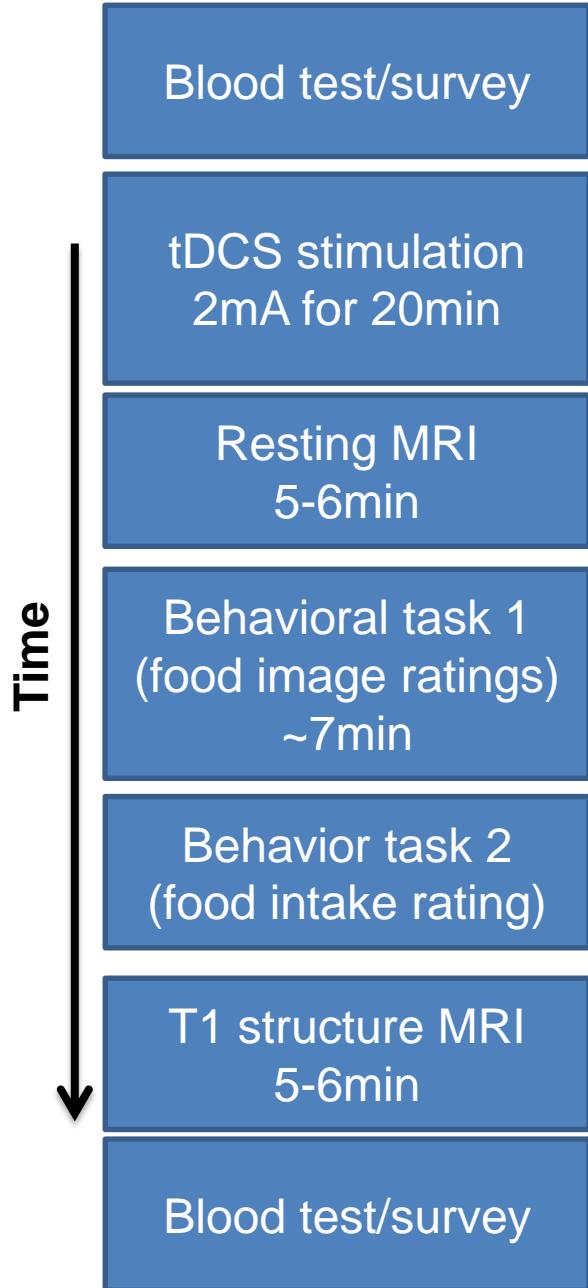
# Functional Connectivity

N=50,000 voxels

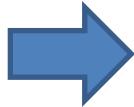
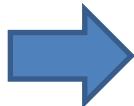
$$N(N - 1)/2 = 1,249,975,000 \text{ Pairs}$$



# 비만 fMRI 연구



fMRI



Food presentation  
max 4sec



Feedback  
1sec

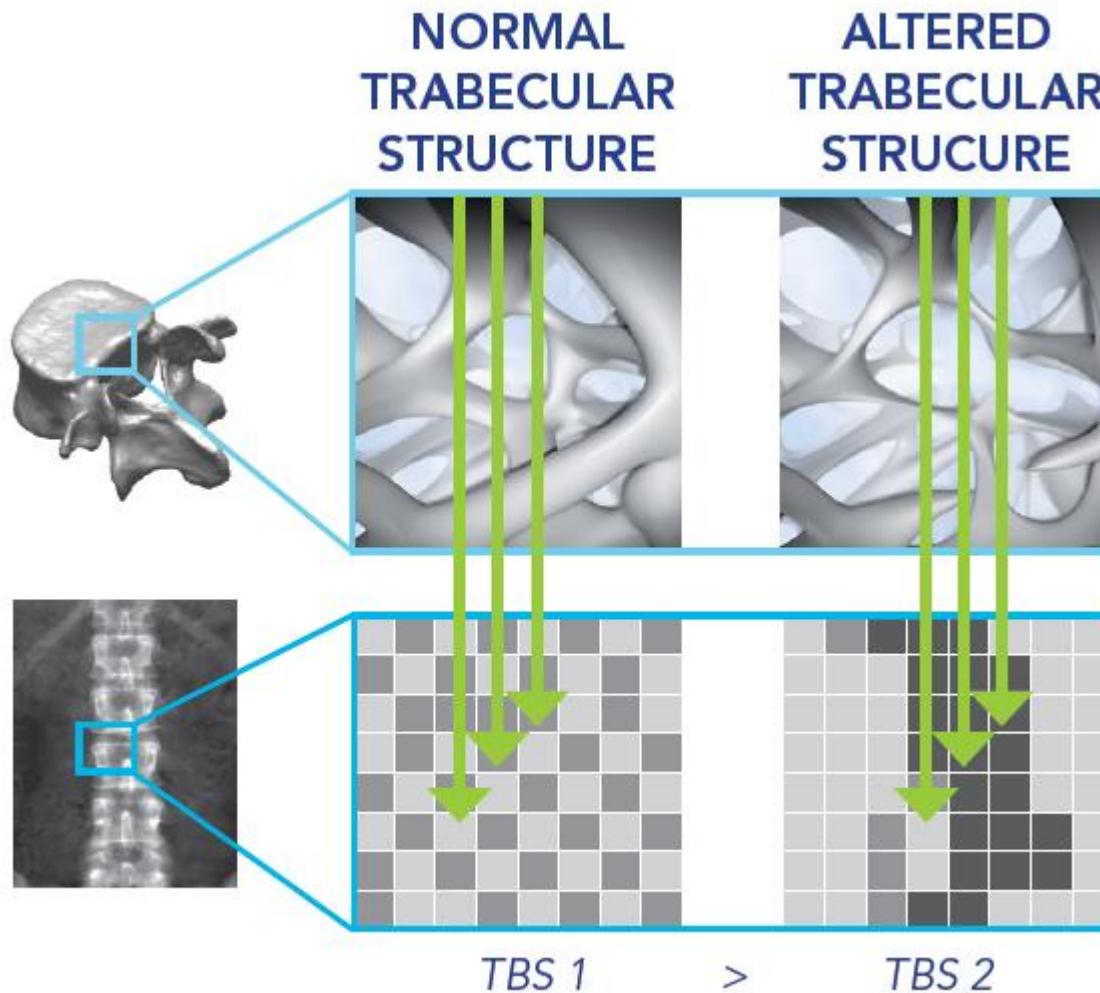
3

Fixation  
1~10sec

+



# Bone Quality and TBS (Trabecular Bone Score)



# Clinical Implication of TBS

Bone Mineral Density images

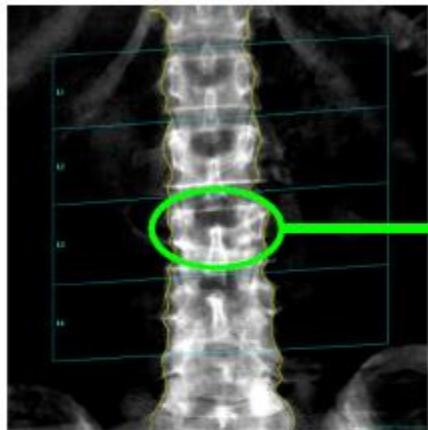
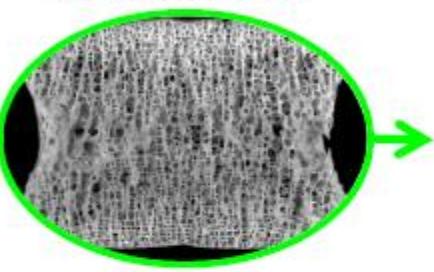


Illustration of a good microarchitecture



Identical BMD

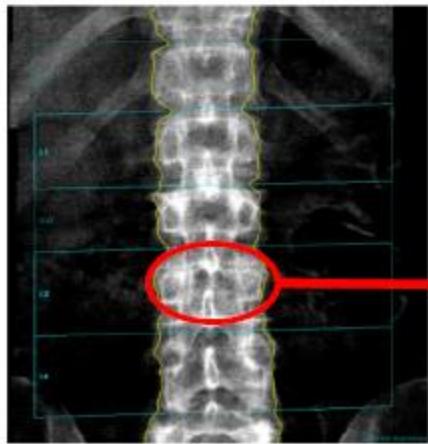
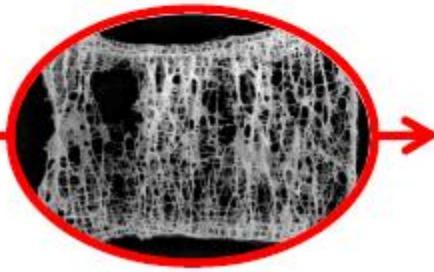
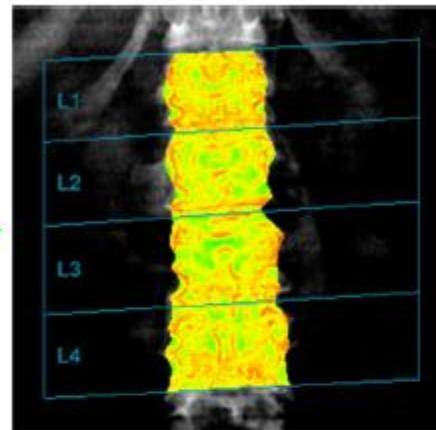


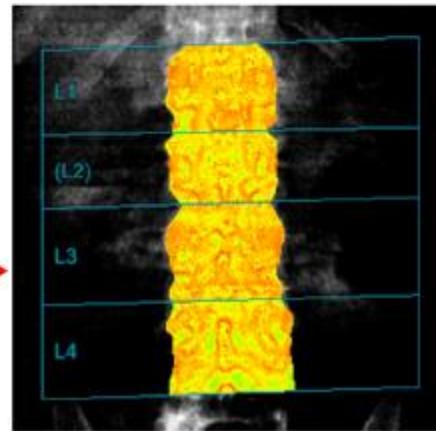
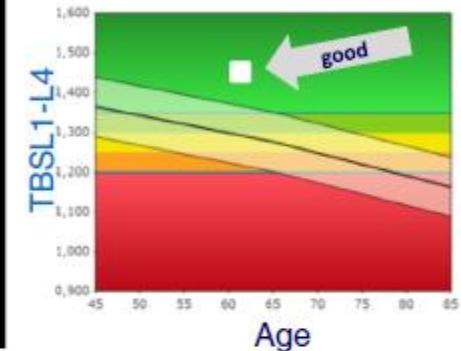
Illustration of a poor microarchitecture



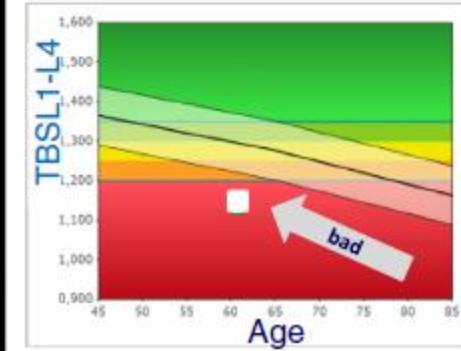
TBS Images and associated reference curves



TBS L1-L4: 1.457



TBS L1-L4: 1.132



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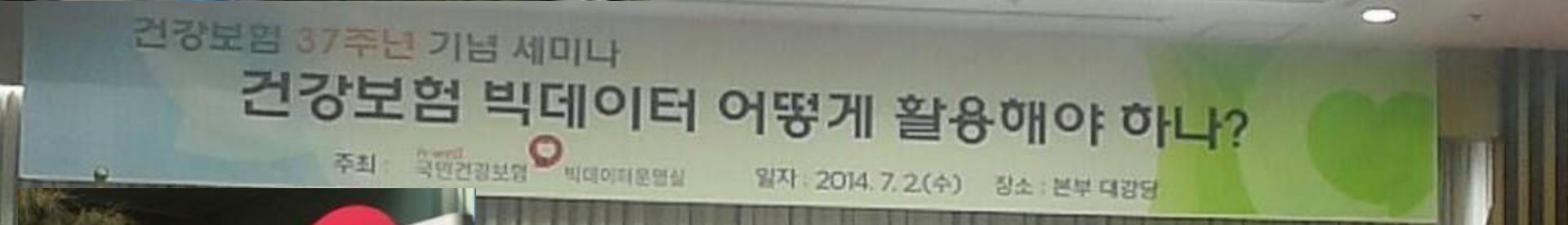
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### ⑤ Genetic Data

## 3. Clinical and Research Applications



Courtesy of Corven Networks

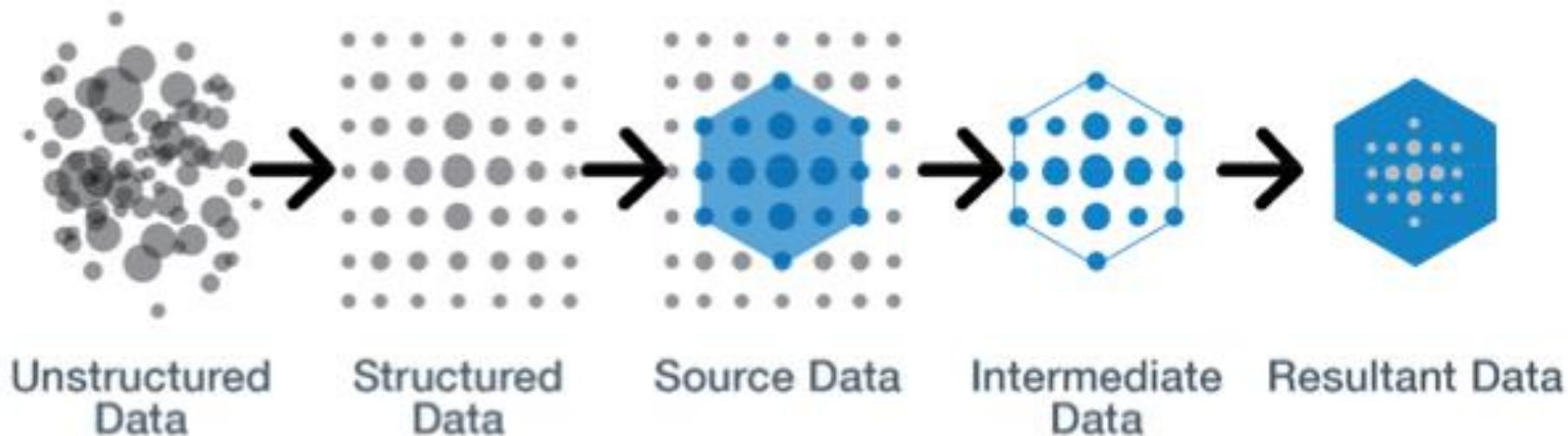


# Overview of secondary data in public health by data source

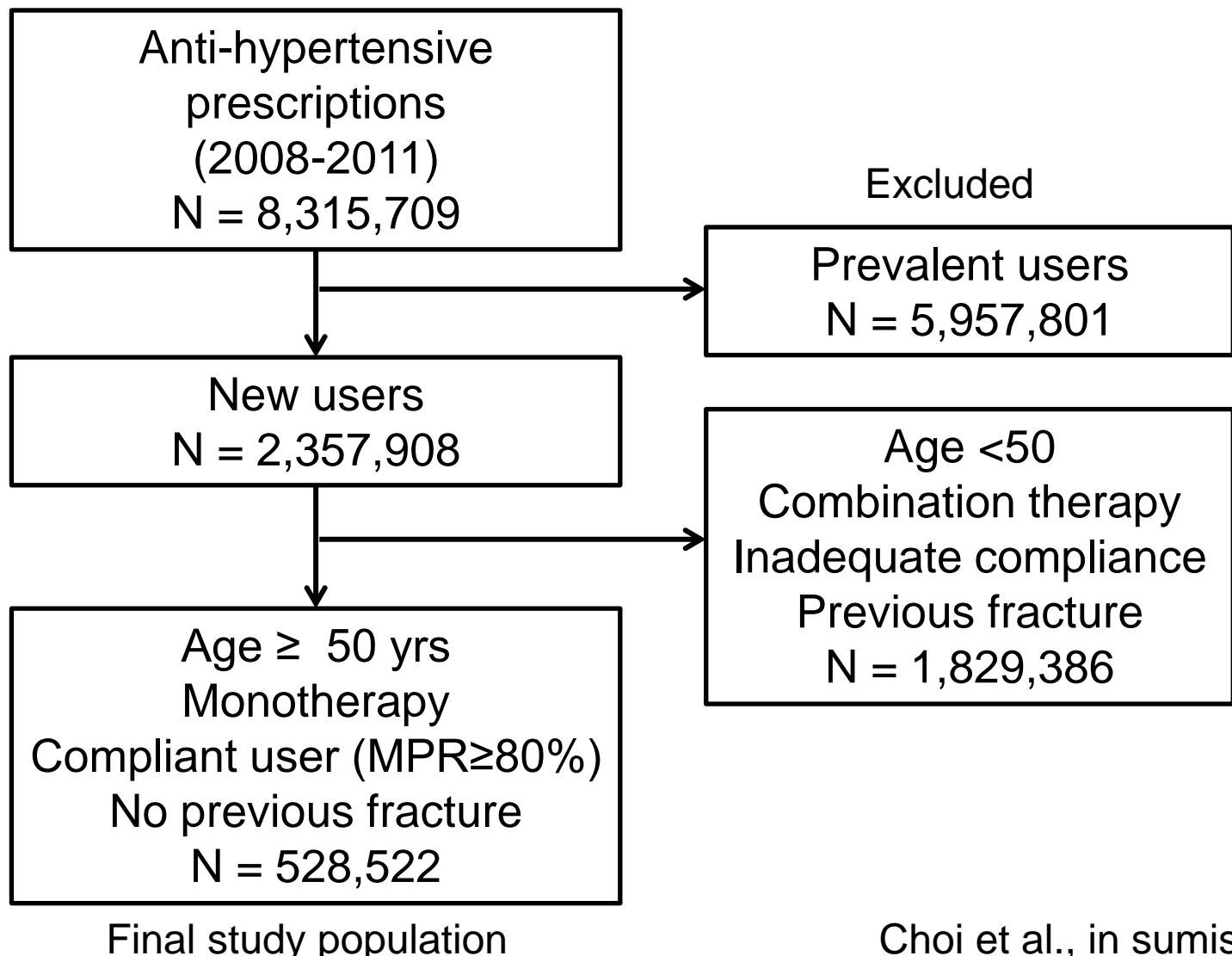
Variable	National health claims data	National health examination	Beneficiary	Cause of death	Cancer registry
	NHIS/HIRA	NHIS	Statistics Korea	National Cancer Center	
Socio-demographics	-	○	○	-	-
Health behavior	-	○	-	-	-
Disease	○	○	-	-	○
Pharmaceuticals	○	-	-	-	-
Lab data	-	○	-	-	-
Cause of death	-	-	Death only	○	-

# Data Variety

## UNSTRUCTURED DATA TO RESULTS



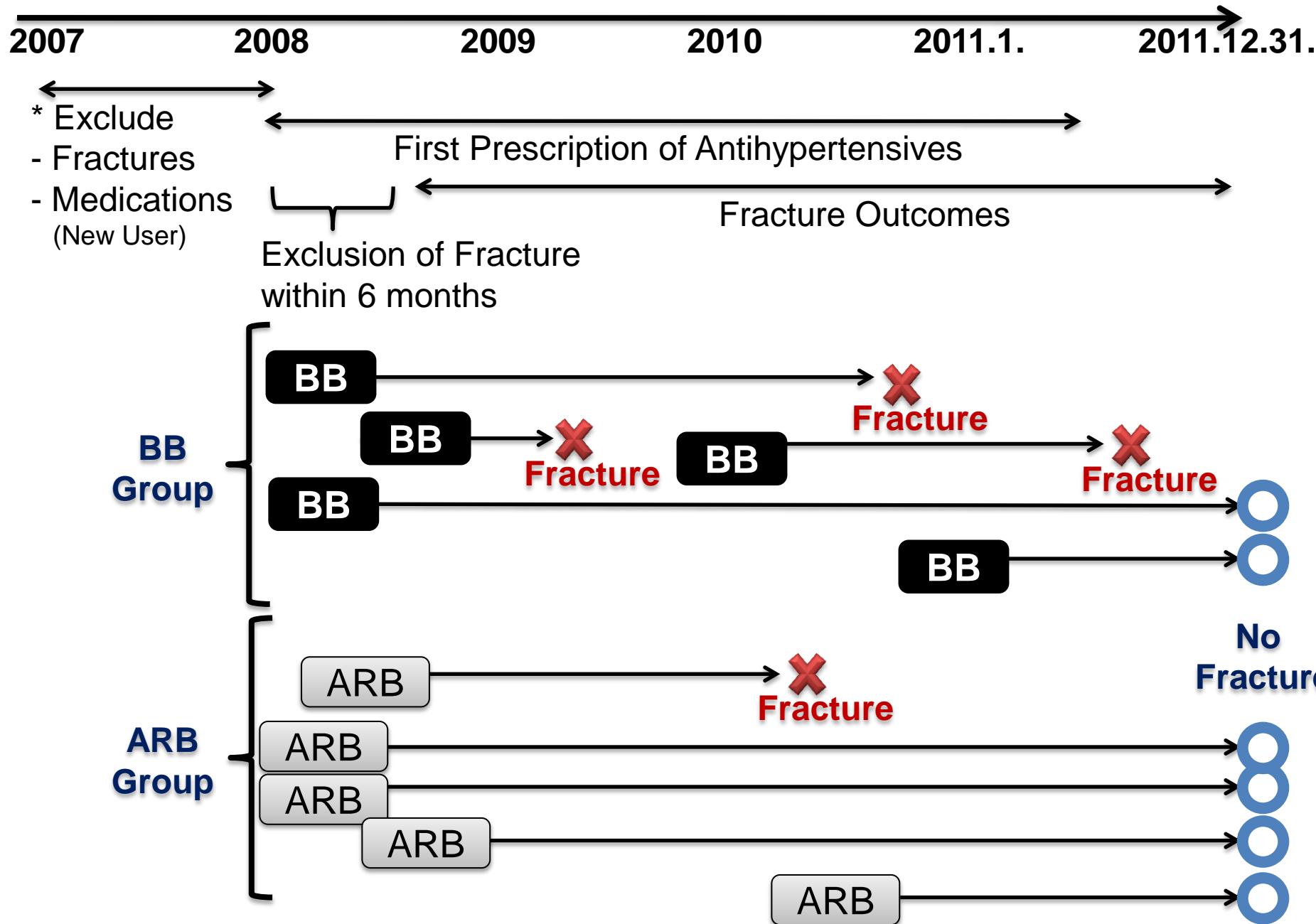
# 심평원 빅데이터 연구 고혈압약과 골절

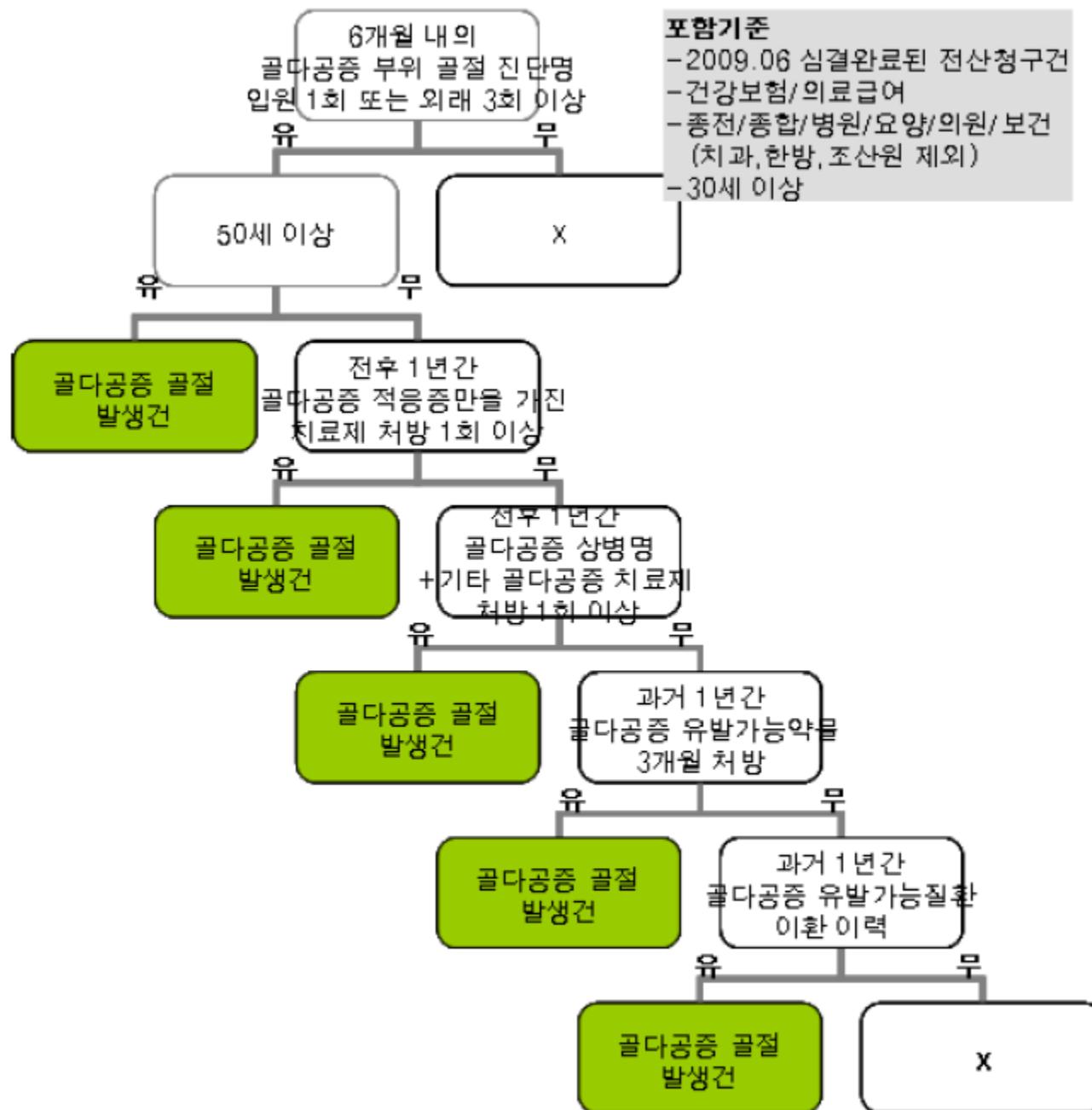


# Design



Cohort study (Health Insurance Review & Assessment Service)  
New-user design (drug-related toxicity)  
Non-user comparator (hypertension without medication)





〈그림 3-2〉 골다공증 골절의 조작적 정의

# Distribution of ARB MPR (Histogram)

Medication Possession Ratio (MPR)

$$= \frac{\text{Total prescription days}}{\text{Observation days}}$$

$$\frac{350 \text{ days (Prescription)}}{365 \text{ days (Observation)}} = \text{MPR} \\ 96\%$$

Frequency Density

3  
2  
1  
0

0

20

80 100 120

300

ARB Non-user

ARB user

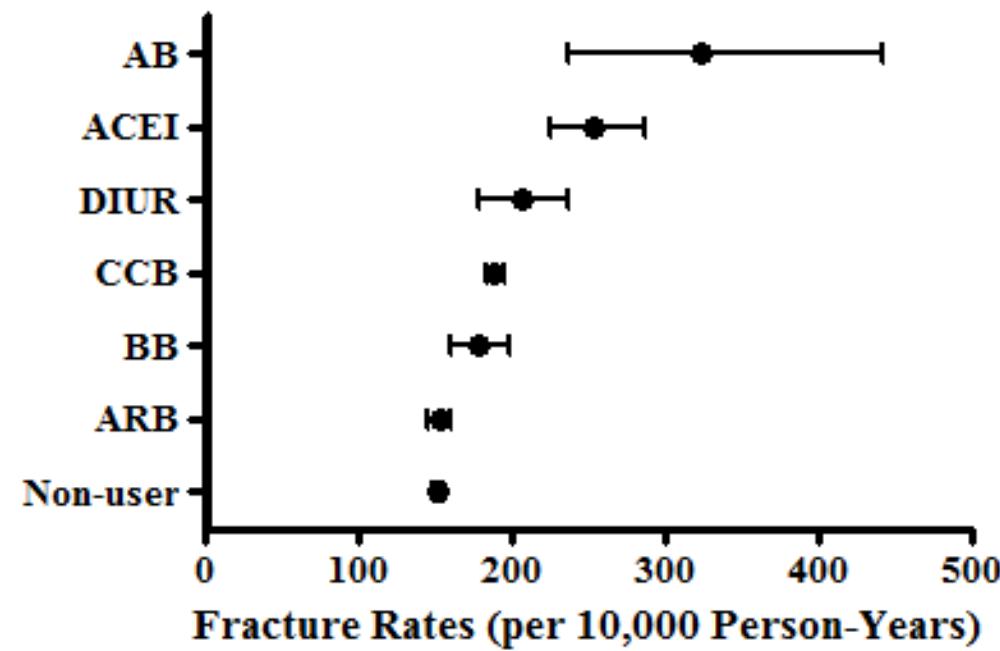
MPR (%)



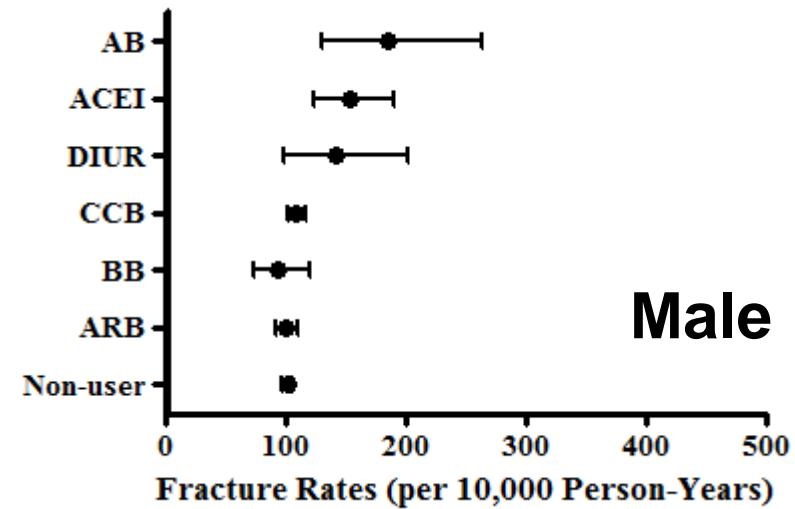
ARB user

# Fracture Rates (per 10,000 Person-Years)

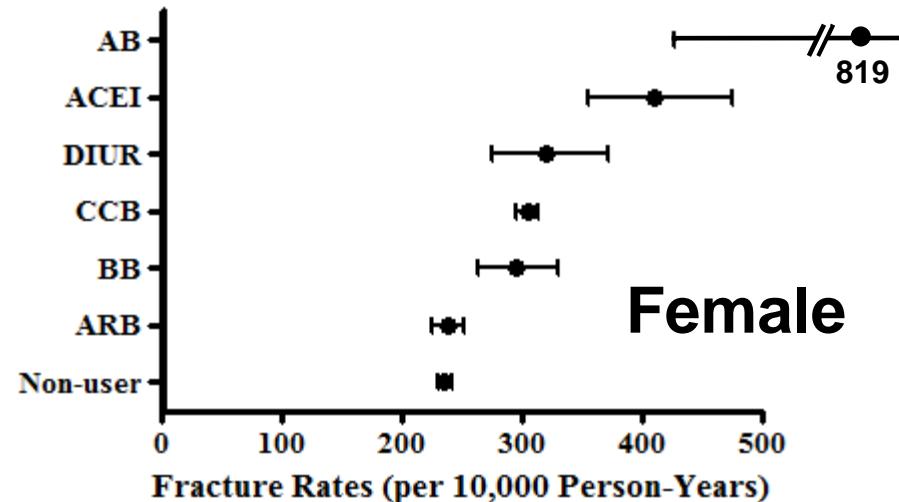
## Total



## Male



## Female



AB: alpha-adrenergic blocker

ACEI: angiotensin converting enzyme inhibitor

DIUR: diuretics

CCB: calcium channel blocker

BB: beta-adrenergic blocker

ARB: angiotensin-receptor blocker

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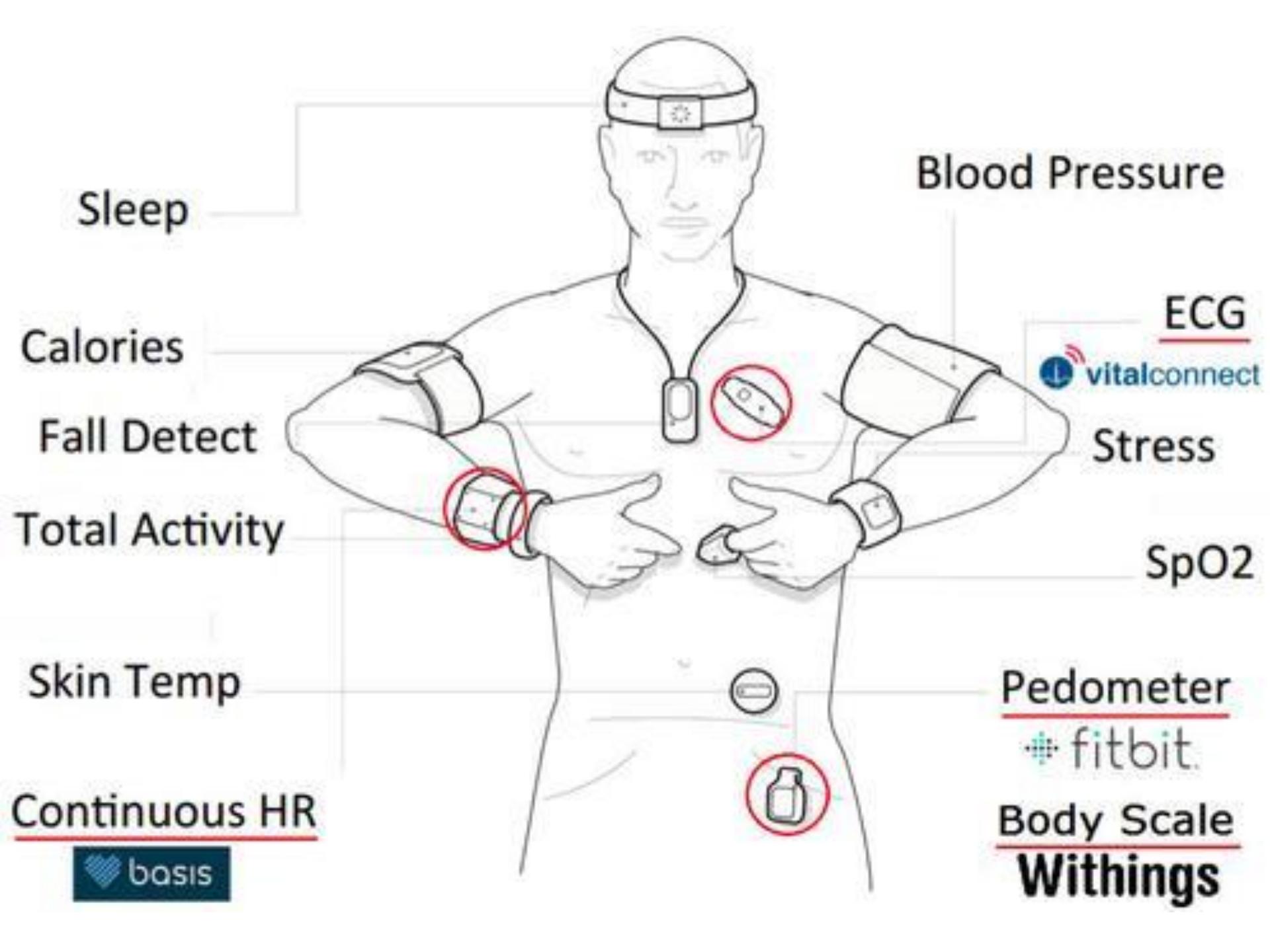
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Courtesy of Corven Networks





S헬스

SAMSUNG

삼성전자



SMART DEVICE™



취소 완료

2014/05/26

오후 12:24

식전

103

mg/dL

100

110



노트

댓글



혈당



오늘

식전

■ 비정상 범위 ~69 or 101~  
(KDA 통계)



103 mg/dL



+ 업데이트

식후

■ 비정상 범위 ~89 or 141~  
(KDA 통계)



91 mg/dL



+ 업데이트





최소 | 완료

2014/05/26

오후 12:25

심장 수축기

110

mmHg

심장 확장기

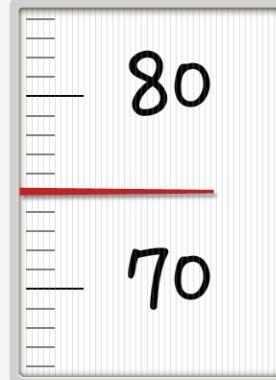
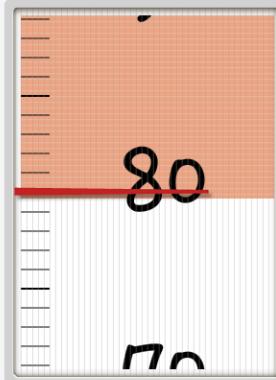
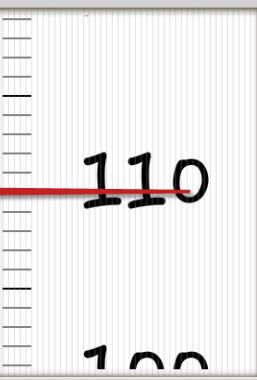
80

mmHg

맥박

75

bpm





취소 완료

## 치즈햄버거스테이크

1회 제공량

1.6

0 접시(g)

4 접시(g)

칼로리: 694.4

영양 정보

칼로리: 434.0kcal

총 지방: 22.17123g

총 탄수화물: 28.2998g

단백질: 26.78039g

Welstory 제공



푸드 트래커



오늘



1522 kcal

595kcal 남음



+ 식사 추가





## 기록 내용

2014년 5월 (평균 423 kcal)



5/26 (월)

칼로리 1522 kcal



563 kcal

아침

오후 12:27



959 kcal

점심

오후 12:26

5/22 (목)

칼로리 3909 kcal



1992 kcal

아침

오후 12:34



1480 kcal

저녁

오후 12:34



437 kcal

점심

오후 12:33

5/18 (화)

칼로리 3553 kcal



15 kcal

스낵

오후 4:00



714 kcal

아침

오후 12:31



274 kcal

점심

오후 12:31



2550 kcal

오후 12:31



## 푸드 트래커



시간

일

월

4300  
(kcal)

2014/05/22

3909 kcal

2150

2117 목표

■ 아침

■ 점심

■ 저녁

■ 스낵





혈당



혈압계

인식된 액세서리

혈압계에서 혈압 데이터를 바로 받을 수 있습니다.

인식된 혈압계



심박계

심박수를 기록할 수 있도록 심박계를 가슴에 고정하세요. 심박계가 연결되어 있으면 실시간 코칭으로 운동과 관련된 음성 및 시각 피드백을 제공합니다.

인식된 심박계

검색 중...



검색 중...

# 혈당관리

홈 | 내정보관리 | 사이트맵

혈당관리에 센스가 필요한 시간  
**센스다이어리**

충북대병원 / 최형진님

당지킴이\_예제보기 **GO**

당지킴이\_예제보기 0개

New] (멘토) 3개

0개

고 1웃

김 5

김 12

남 19

박 26

전 27 28 29 30 31

혈당값다운로드

당뇨수첩입력

결과보기

혈당관리안내

커뮤니티

## SENSDIARY 01 혈당값다운로드

혈당기 속 나의 혈당을 온라인  
센스다이어리에서 관리하세요.



## SENSDIARY 02 당뇨수첩입력

당뇨 관리, 이제는 쉽게하세요.  
당뇨 치료, 관리가 최선입니다.



## SENSDIARY 03 결과보기

내 혈당관리가 잘 되고 있는지  
센스다이어리에서 확인하세요



# 혈당 관리

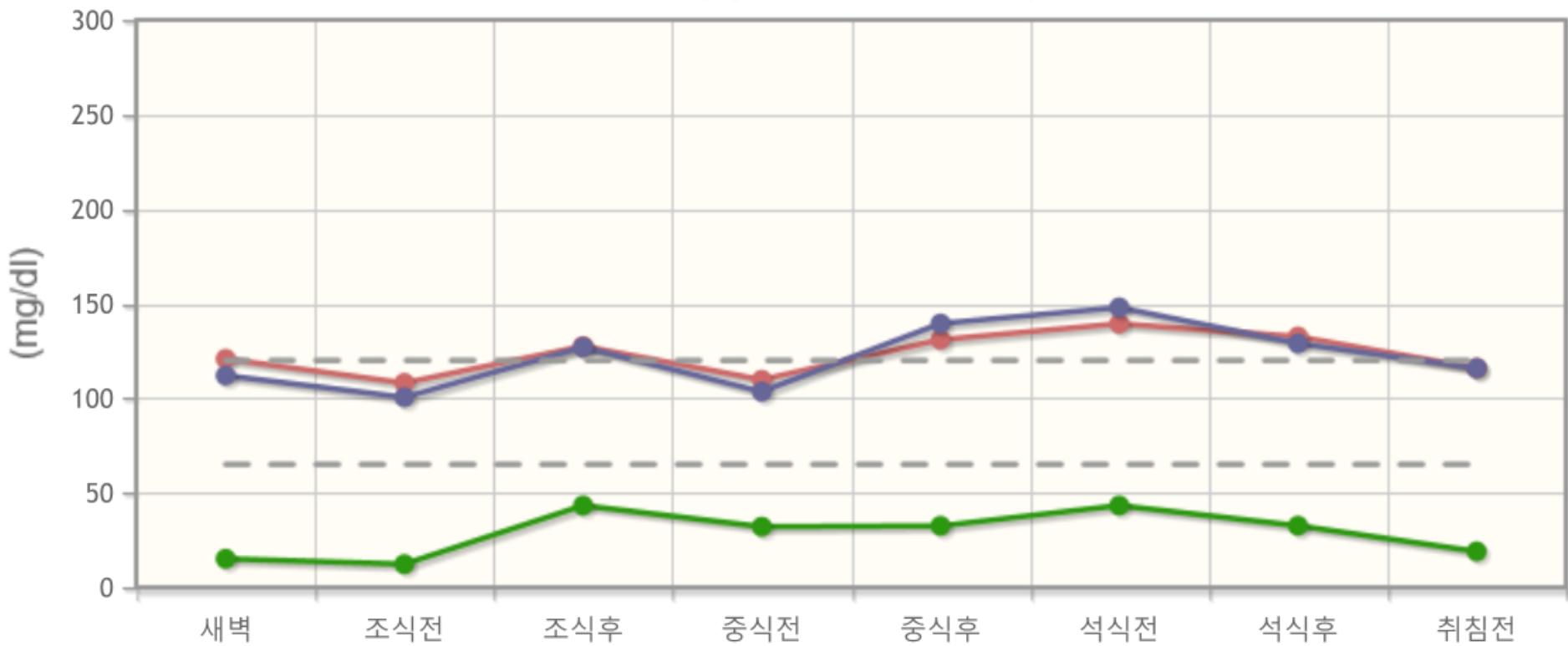
데/이/터/써/머/리

1형당뇨혈당값	2형당뇨혈당값	그래프보기	혈당데이터 요약	혈당측정값전체보기	나의통계보기	메모보내기
<b>내용보기</b>	최근14일	2014-07-09	2014-07-23	검색 >		
날짜	새벽	조식전	조식후	중식전	중식후	석식전
2014-07-23	0	93	0	0	0	0
메모						
2014-07-22	112	108	151	111	<b>142</b>	0
메모						
2014-07-21	0	105	<b>127</b>	119	108	0
메모						
2014-07-20	109	115	169	88	130	109
메모						
2014-07-19	125	134	117	<b>101</b>	83	0
메모						
2014-07-18	<b>136</b>	0	155	<b>116</b>	191	<b>199</b>
메모						
2014-07-17	0	0	119	<b>116</b>	0	190
메모						
혈당값평균	<b>121</b>	<b>111</b>	<b>140</b>	<b>109</b>	<b>131</b>	<b>166</b>
						고:주황색 저:청색 (단위 : mg/dL)

# 혈당관리

[2014-07-15 ~ 2014-07-29]

최근14일내 평균값 중앙값 표준편차





# Apple Healthbook



Made for  
**iPhone**

 Emergency Card	 Activity	14,950 steps
 Bloodwork	 Nutrition	
 Heart Rate 85 bpm	 Blood Sugar 110 mg/dL	
 Hydration	 Sleep	
 Blood Pressure 120/80 systolic/diastolic	 Respiratory Rate	
 Activity 14,950 steps	 O <sub>2</sub> Oxygen Saturation	
 Nutrition	 Weight 190	

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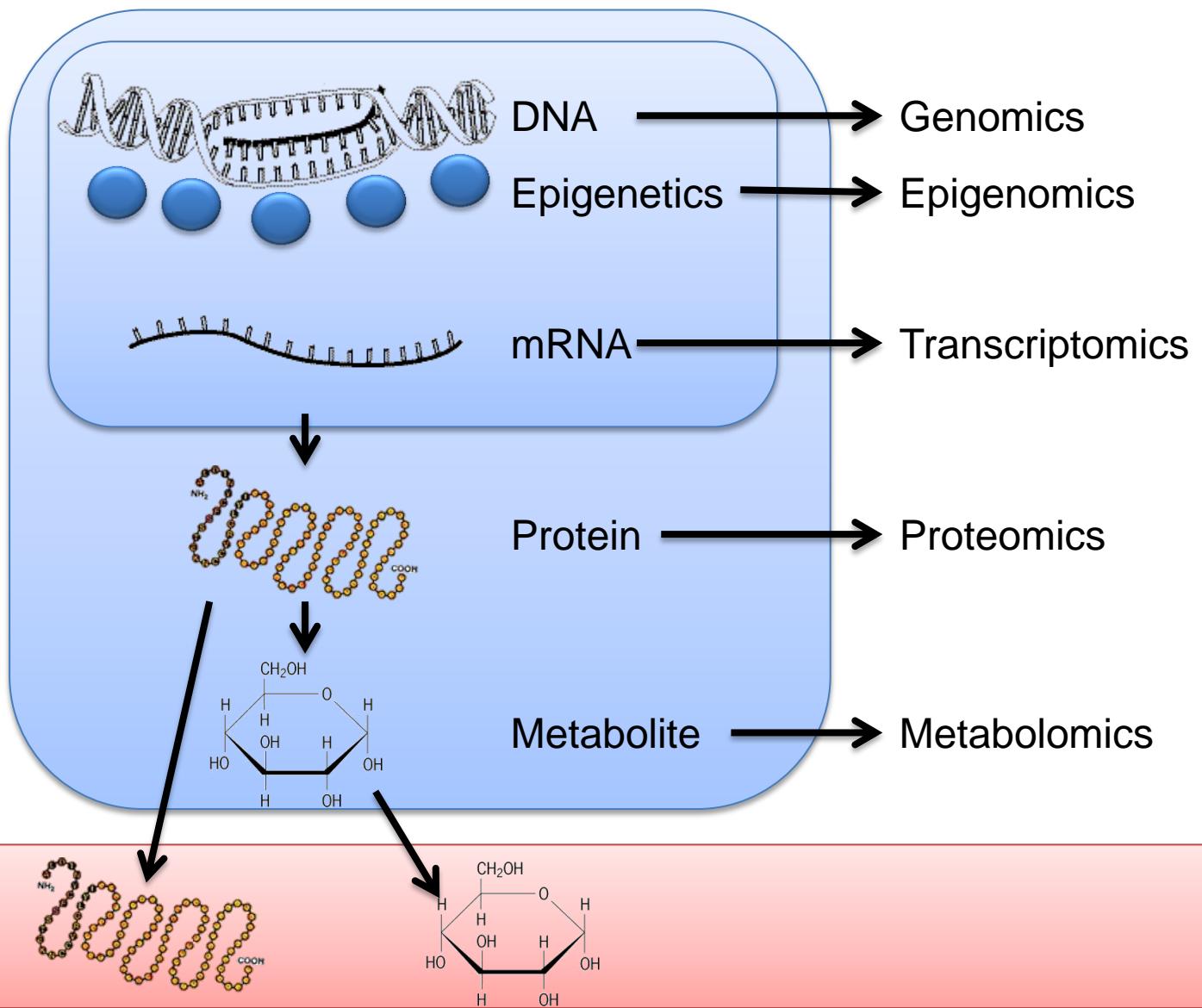
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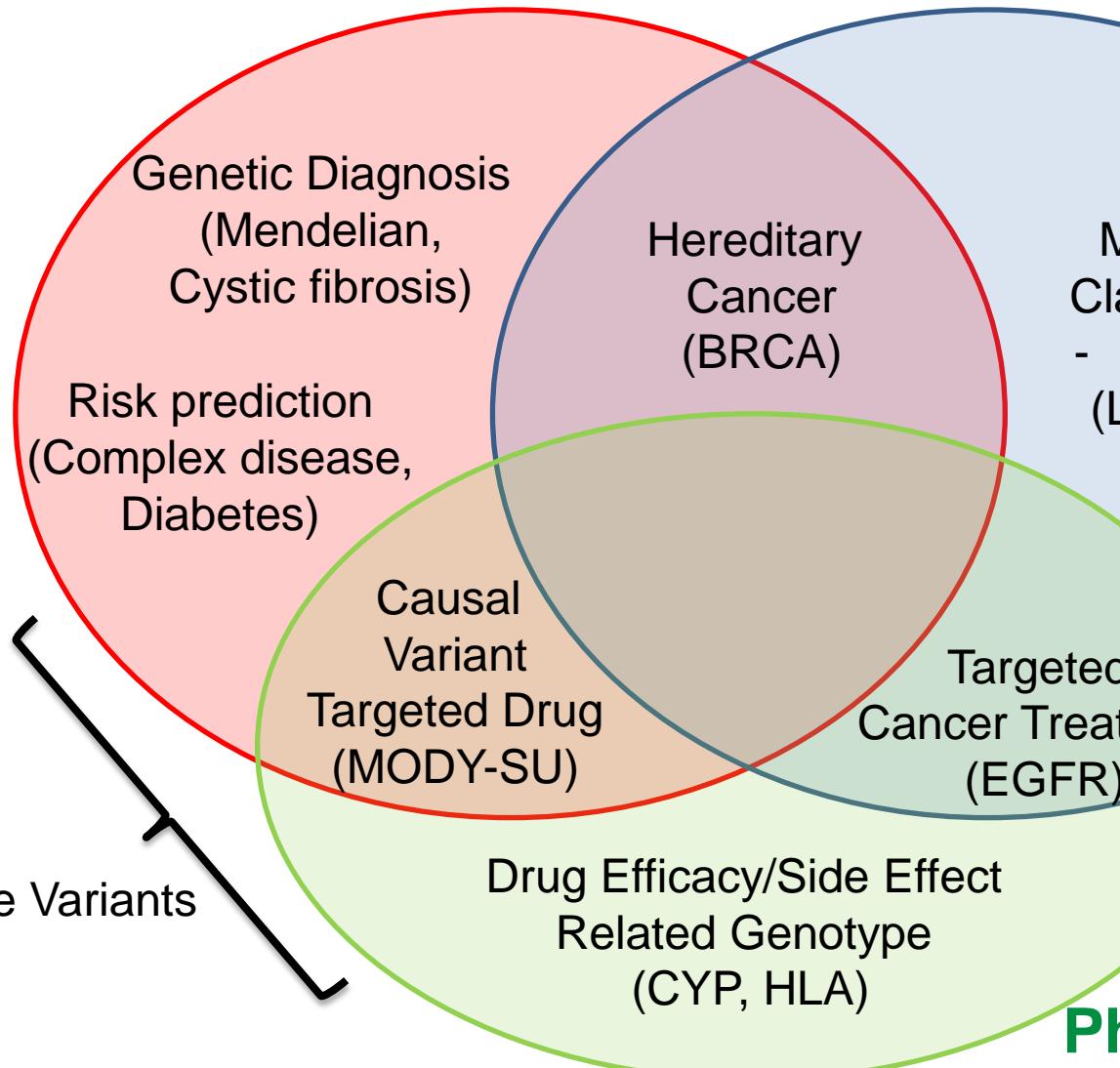
Courtesy of Corven Networks

# Genetics Information and OMICs



# Genomic Medicine

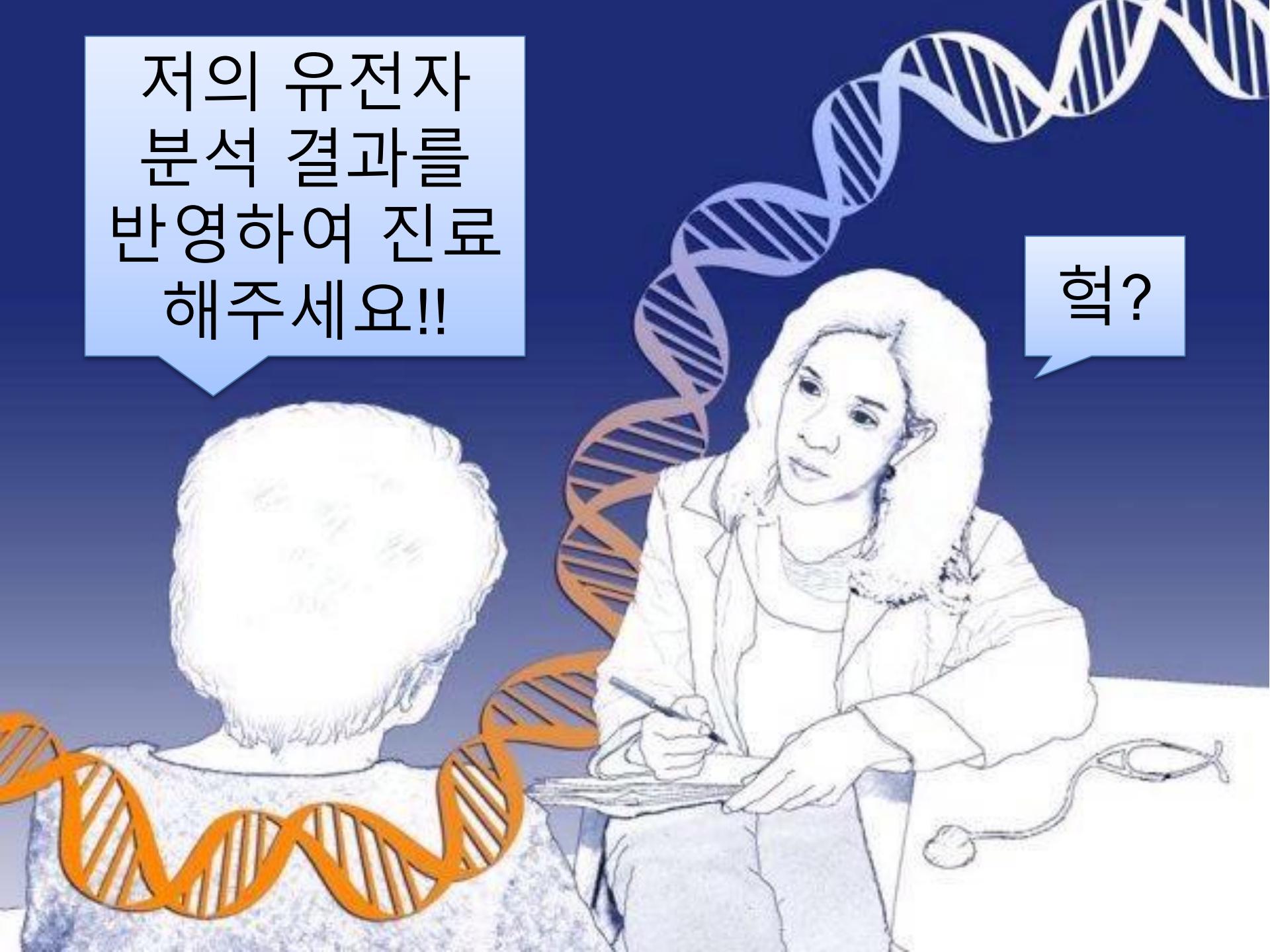
Disease genetic susceptibility



Cancer driver somatic mutation

Pharmacogenomics

Microbiome (Bacteria, Virus)



저의 유전자  
분석 결과를  
반영하여 진료  
해주세요!!

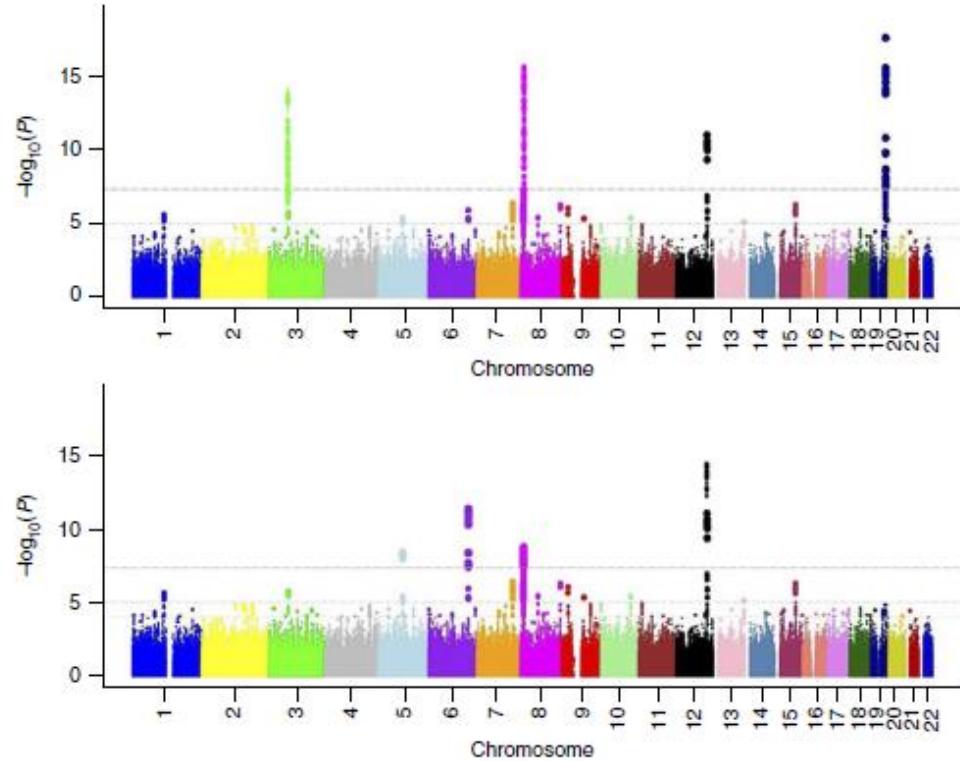
헐?

# Whole-genome analyses of whole-brain data: working within an expanded search space

Sarah E Medland<sup>1,13</sup>, Neda Jahanshad<sup>2,3,13</sup>, Benjamin M Neale<sup>4–6</sup> & Paul M Thompson<sup>2,3,7–12</sup>

# Voxel-wise GWAS

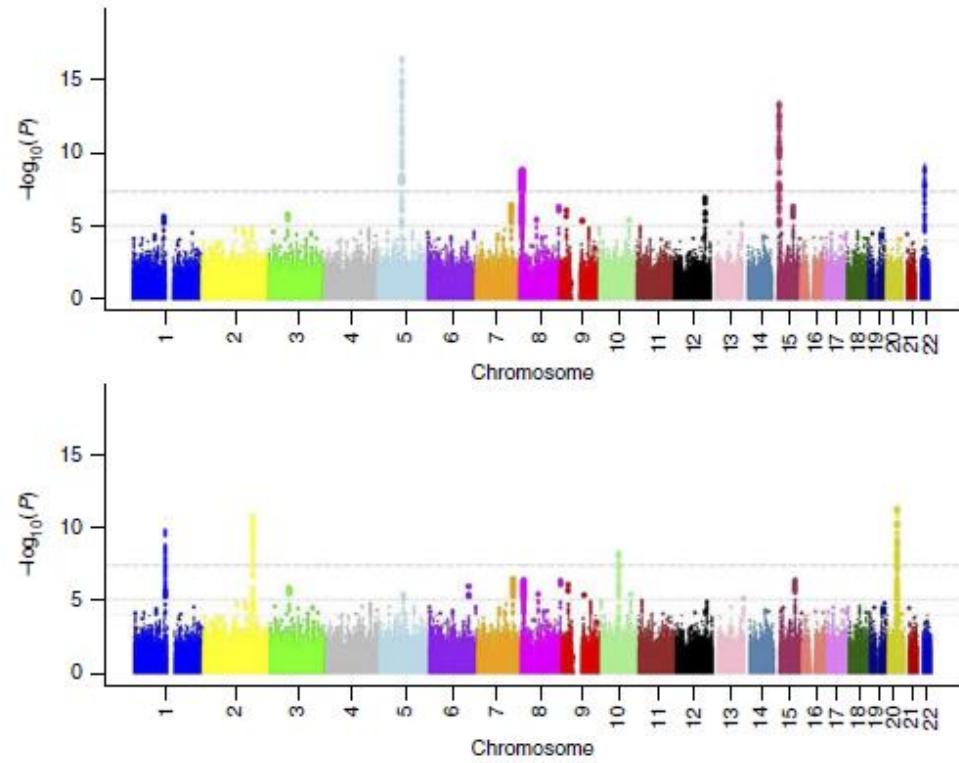
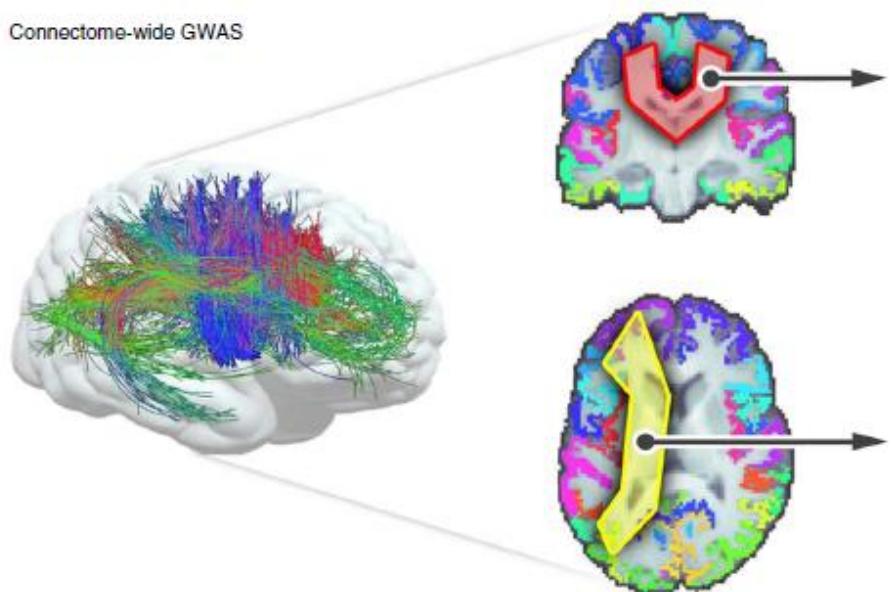
a



# Connectome-wide GWAS

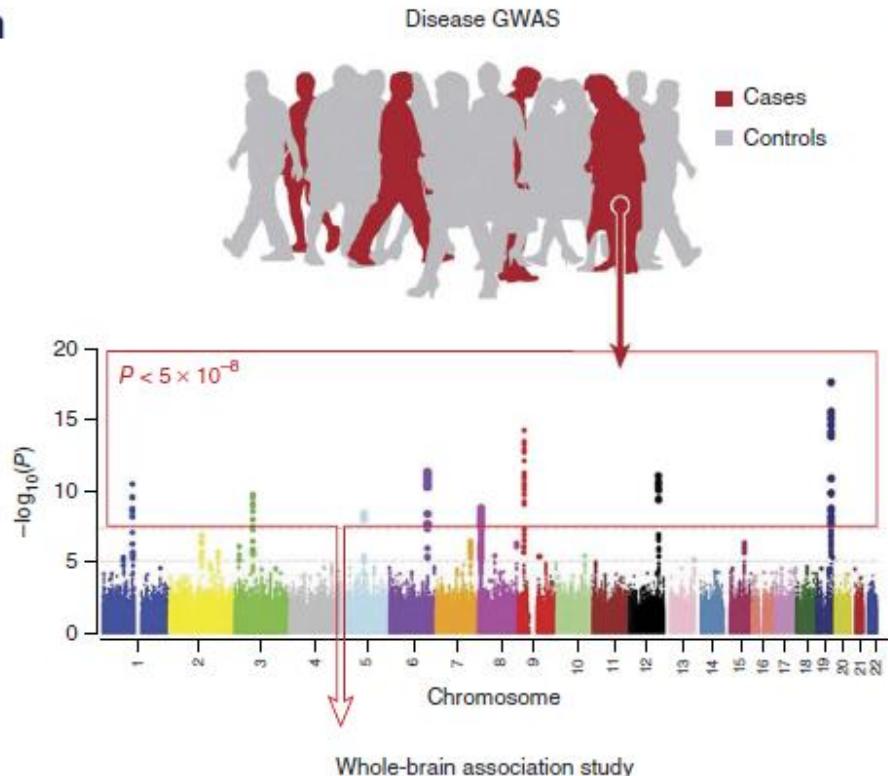
b

Connectome-wide GWAS

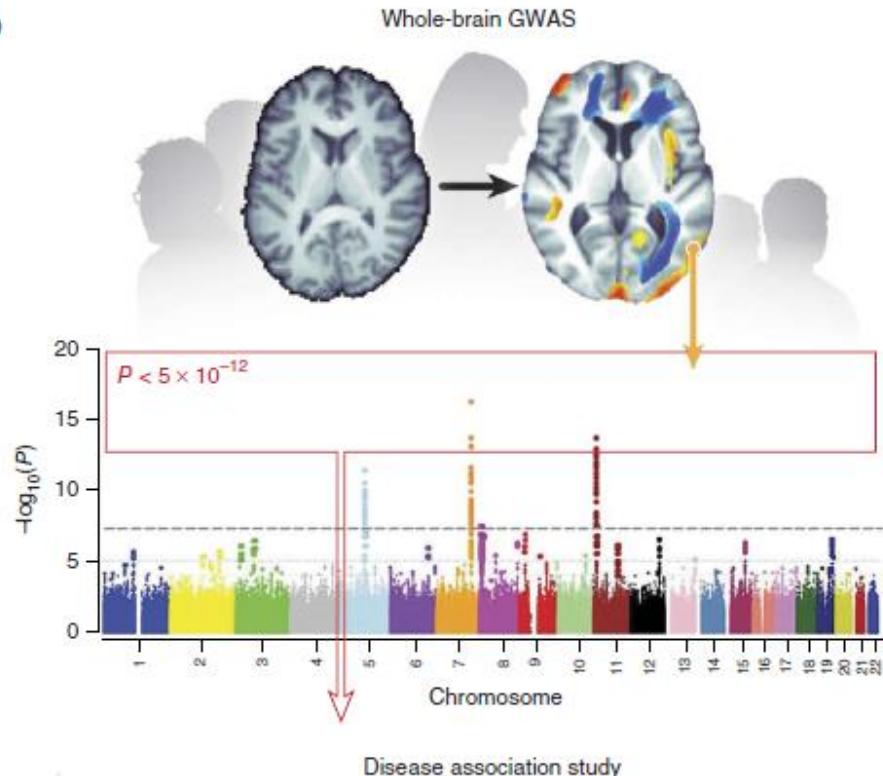


# Disease GWAS vs. Whole-brain GWAS

a



b



## 사이버상의 헬스 아바타



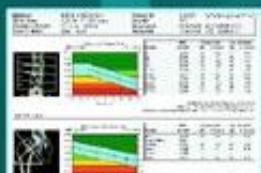
### 유전자 정보

특정 암 유발 또는 가족이  
잘 걸리는 질병 유전자 자료 입력



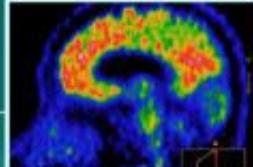
### 심전도

U헬스 의료기기를 통해 집에서  
체크한 검사 정보 자동 전송



### 진료 기록

병원에서 환자의 병세를 쉽게  
알 수 있는 핵심 자료 입력



### 의료영상

병원에서 질병 발견과 치료  
목적으로 활용한 영상 전송



### 일상활동 정보

스마트폰 등으로 운동량,  
설취 칼로리 양 자동 전송



### 투약 기록

약국에서 환자가 구매한 약물  
기록 입력

## 현실세계에서 평가

그래픽=양민성 기자 in7@chosun.com



### 의사

여러 진료과의 의사가  
집속해서 환자가 어떤  
질병에 걸릴 위험이 있는지  
분석하고 치료 방향 제시.



간호사, 영양사,  
운동처방사 등  
환자의 질병 관리  
문제점 분석, 생활  
습관 개선 방향 제시.



### 생명공학자

유전자 정보 분석하여  
어떤 질병이 위험하고  
무슨 암을 조심해야  
하는지 예측.



### 의료정보학자

환자의 의료  
기록을 분석  
하고 통합 관리.

## 스마트폰 '헬스아바타' 진료시스템 개요



August 01, 2014

## Notice

바이오 전문가의 꿈 키워요

분야별뉴스 | 과학기술 | 보건 · 의학

## 병원간 의료정보 교류 시대 연다

K-헬스케어 3.0 프로젝트 시범사업 추진

### Digital Hospital

- 전자 의료 기록 시스템
- 처방 전달 시스템
- 의료영상 저장정보 시스템
- 통합 환자 중심 환경



### u-Health

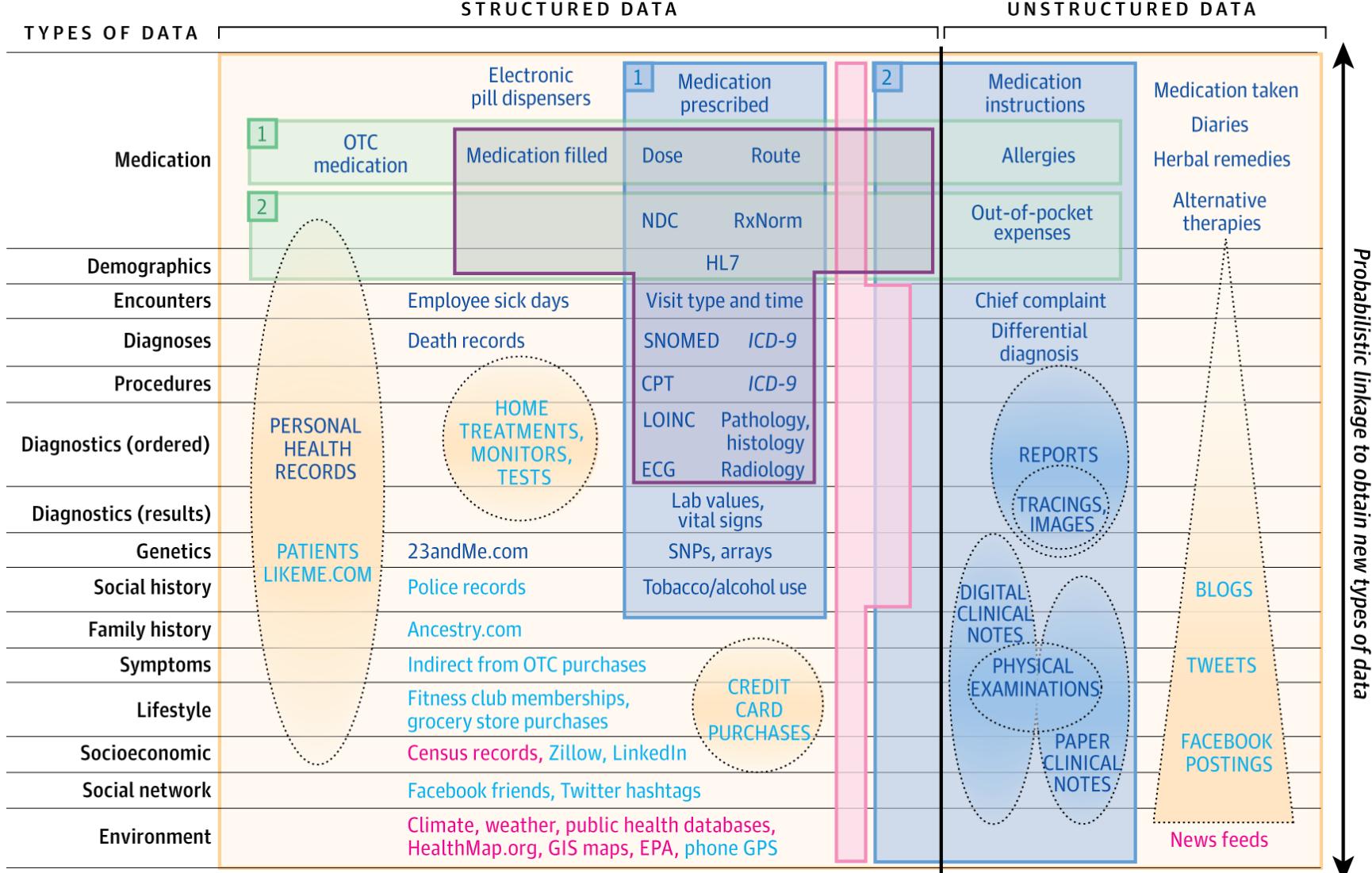
- 실시간 건강 관리 서비스
- 스마트 케어 처방/관리
- 모바일 의료 솔루션

### Health 2.0

- 개인 맞춤형 의료서비스
- 웹기반 진료 정보 공유

여름휴가를 맞아 가족들과 여행을 떠난 40대 후반의 김 모 씨는 중증의 천식 환자다. 그래서 기침이 나지 않도록 늘 조심을 한다. 그런데 이번 여행길에서는 챙겨간 천식약이 모자라 복용량이 충분치 못했던 까닭에 호흡곤란이 시작되면서 고초를 겪게 됐다.

가족들은 호흡곤란으로 고로워하는 김 씨를 근처의 종합병원으로 긴급히 후송하였다. 불행 중 다행으로 김 씨는 지난달 '의료정보교류 서비스'에 가입해 두었던 터라, 이내 의료진은 의료정보교류 시스템을 통해 김 씨의 과거 진료기록을 신속하게 확인할 수 있었다. 그 결과 혈액검사 등 간단한 검사만으로 빠르고 정확한 진단과 처방을 내릴 수 있었다.



#### Examples of biomedical data

1 Pharmacy data  
2 Claims data

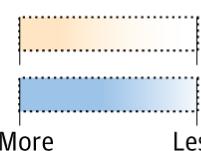
1 Health care center (electronic health record) data  
2 Registry or clinical trial data

Data outside of health care system

#### Ability to link data to an individual

- Easier to link to individuals
- Harder to link to individuals
- Only aggregate data exists

#### Data quantity



# Contents

1. What is Big Data?
2. Healthcare Big Data
  - ① Electrical Health Records (EHR)  
Structured/Unstructured Data
  - ② Medical Images
  - ③ Government Data
  - ④ Behavior/Sensor Data
  - ⑤ Genetic Data
3. Clinical and Research Applications



# The Creative Destruction of



# HOW THE DIGITAL REVOLUTION WILL CREATE BETTER HEALTH CARE

ERIC TOPOL, M.D.

# The Creative Destruction Of Medicine

How The Digital Revolution Will Create Better Health Care

# 청진기가 발전한다?



# New Value Pathways

## Description



### Right living

Informed lifestyle choices that promote well-being and the active engagement of consumers in their own care



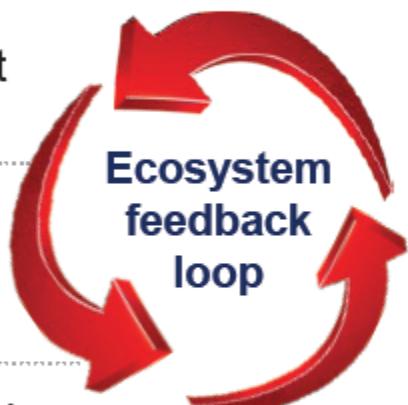
### Right care

Evidence-based care that is proven to deliver needed outcomes for each patient while ensuring safety



### Right provider

Care provider (eg, nurse, physician) and setting that is most appropriate to deliver prescribed clinical impact



### Right value

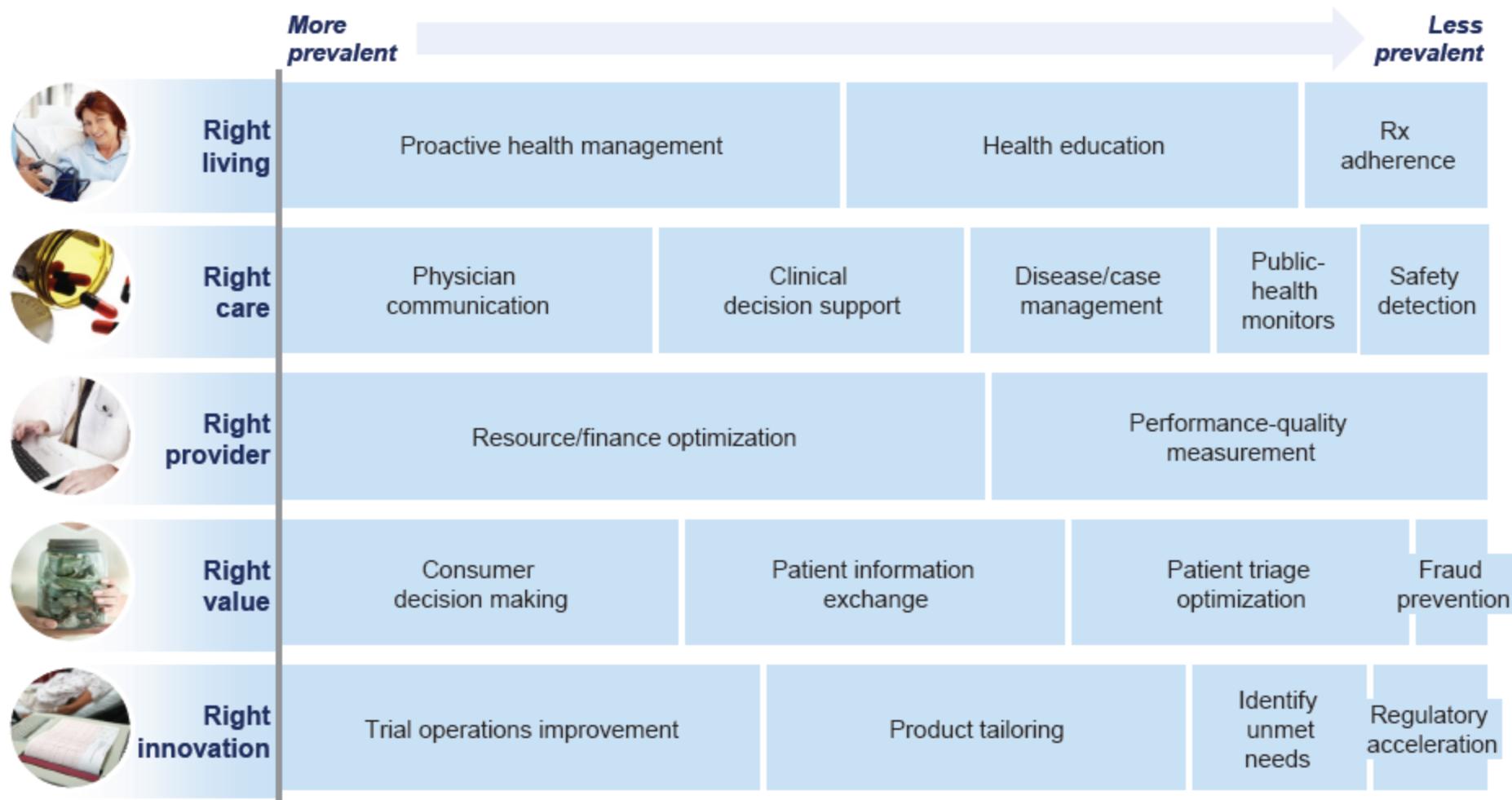
Sustainable approaches that continuously enhance healthcare value by reducing cost at the same or better quality

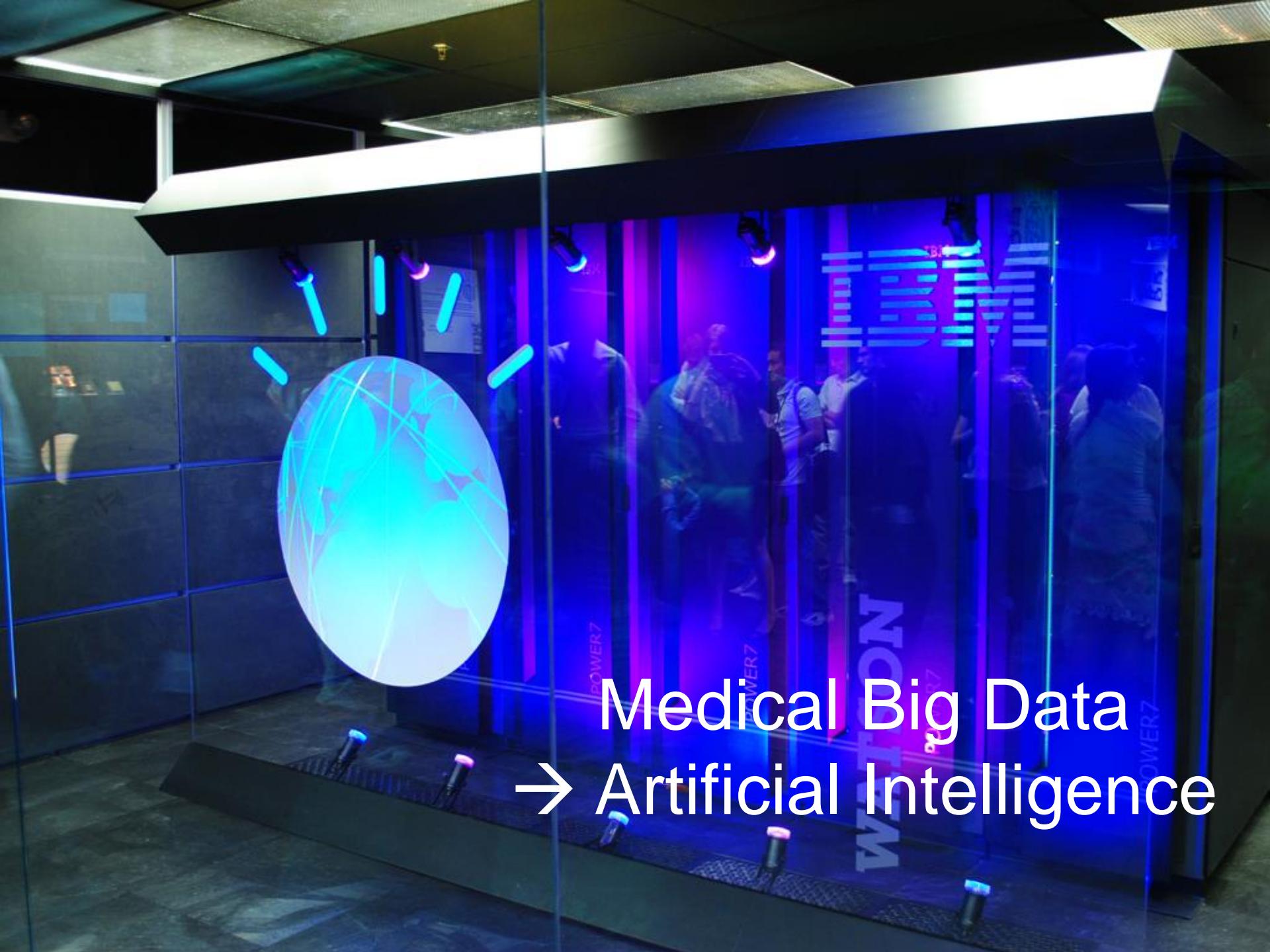


### Right innovation

Innovation to advance the frontiers of medicine and boost R&D productivity in discovery, development, and safety

# Individual Decision Making



A photograph of an IBM exhibition booth. On the left, a large illuminated globe is suspended in a dark space with blue and white glowing lines forming a network. To the right, several server racks are visible, each labeled "POWER7". A large "IBM" logo is displayed on a screen. In the foreground, a large white text overlay reads "Medical Big Data" above a large arrow pointing right, followed by "→ Artificial Intelligence".

Medical Big Data  
→ Artificial Intelligence

# Jeopardy!



2011년 인간 챔피언 두 명과 퀴즈 대결을 벌여서 압도적인 우승을 차지

# IBM's Watson analyzes the human genome to battle brain cancer



Glioblastoma, an aggressive and malignant brain cancer, kills more than

**13,000**

people in the U.S. each year.

New York Genome Center and IBM are partnering in a first-of-a-kind program to accelerate the race to personalized, life-saving treatment for cancer patients.

This Watson application is a cloud-based system that compares genetic data against comprehensive biomedical literature and drug databases.



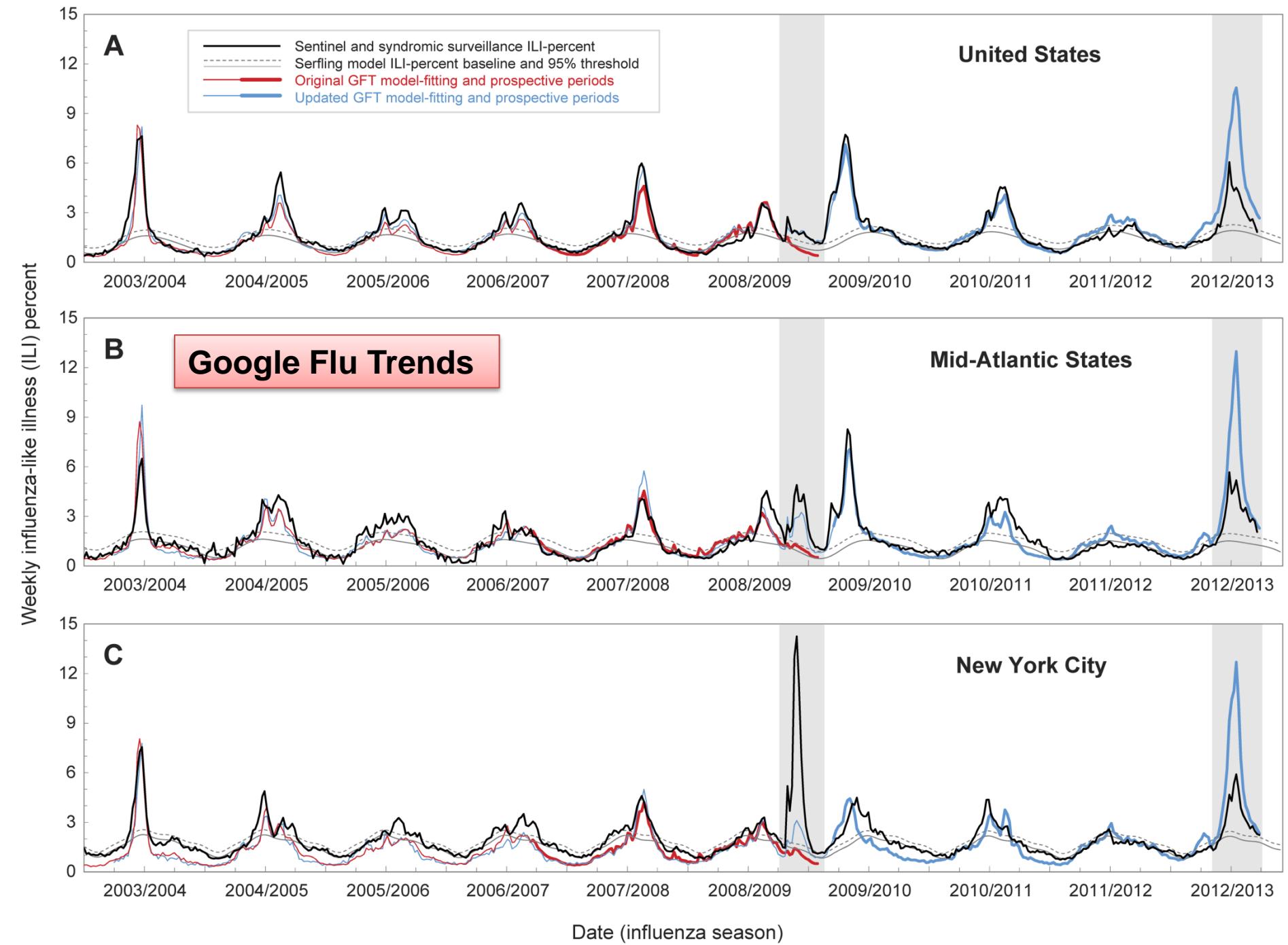
Watson compares billions of DNA samples against the patient's genome sequence and cancer variant...

...and sifts through millions of pages from new studies, medical journals and clinical records.

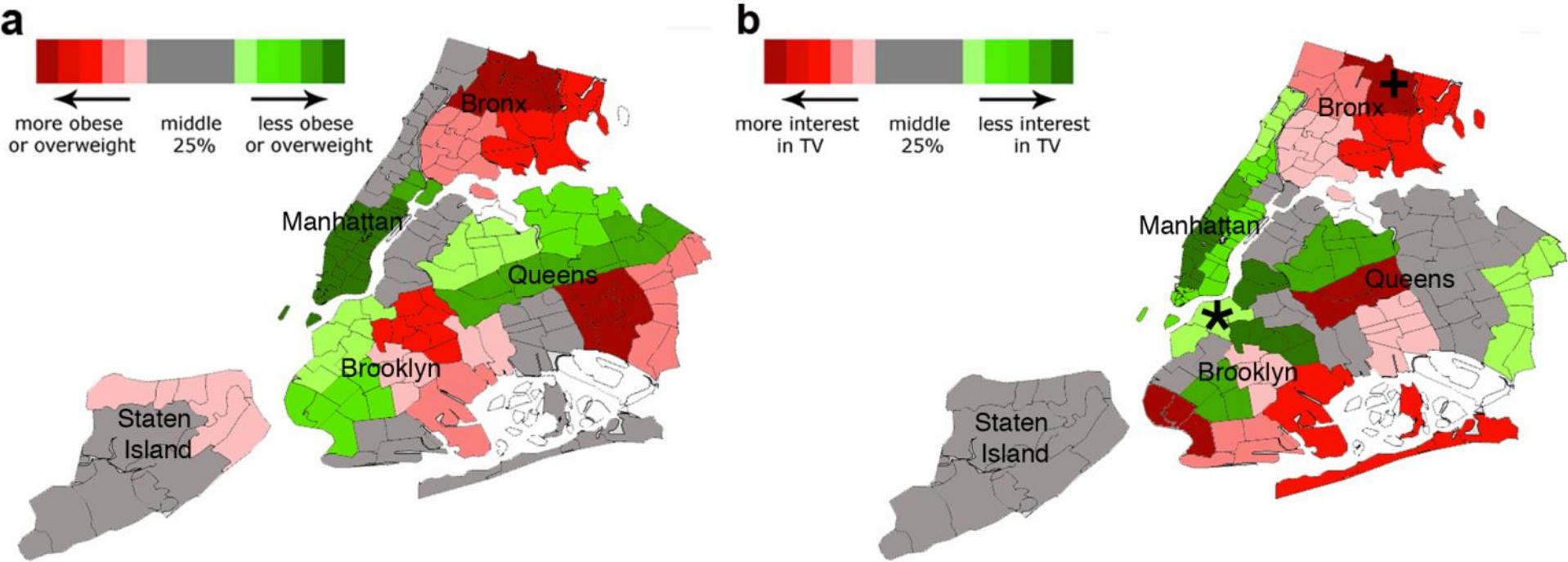
**JAMA** April 9, 2014

VIEWPOINT

## Could Behavioral Medicine Lead the Web Data Revolution?

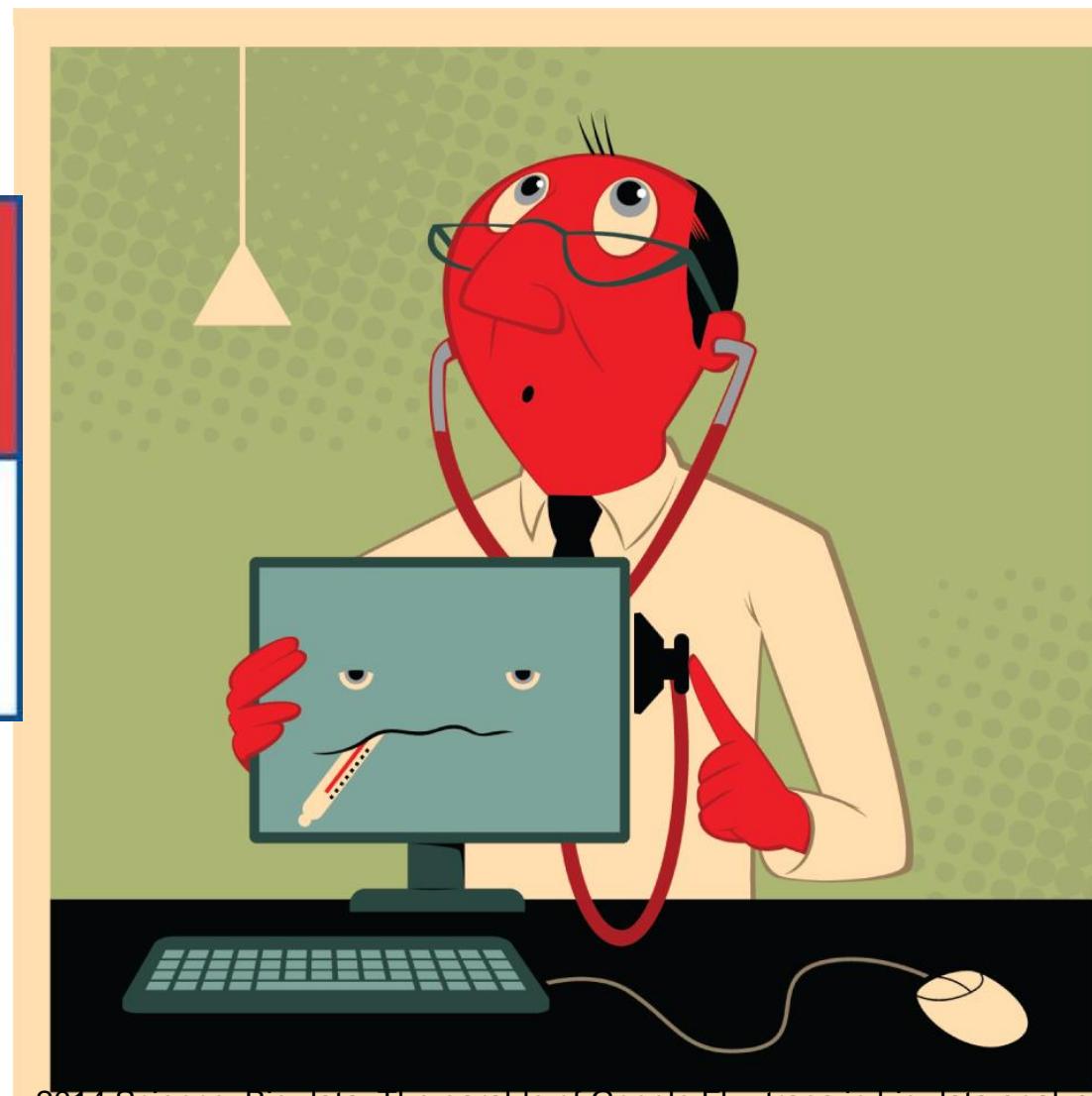


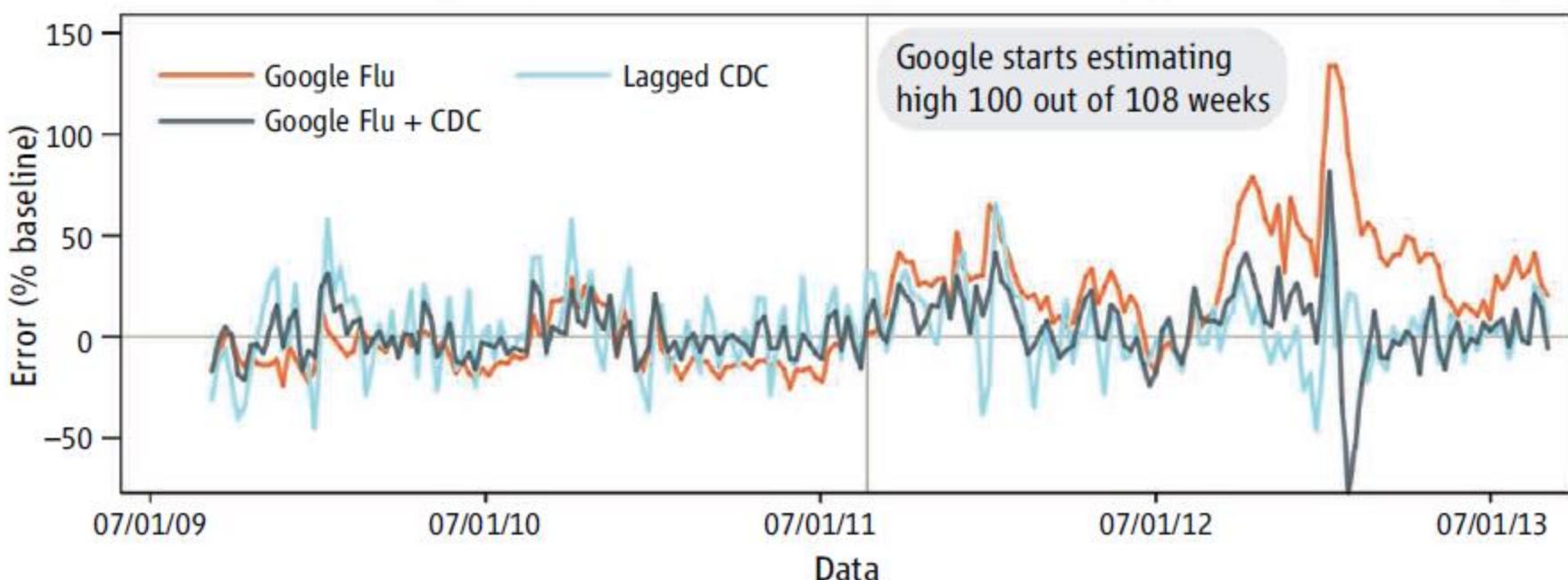
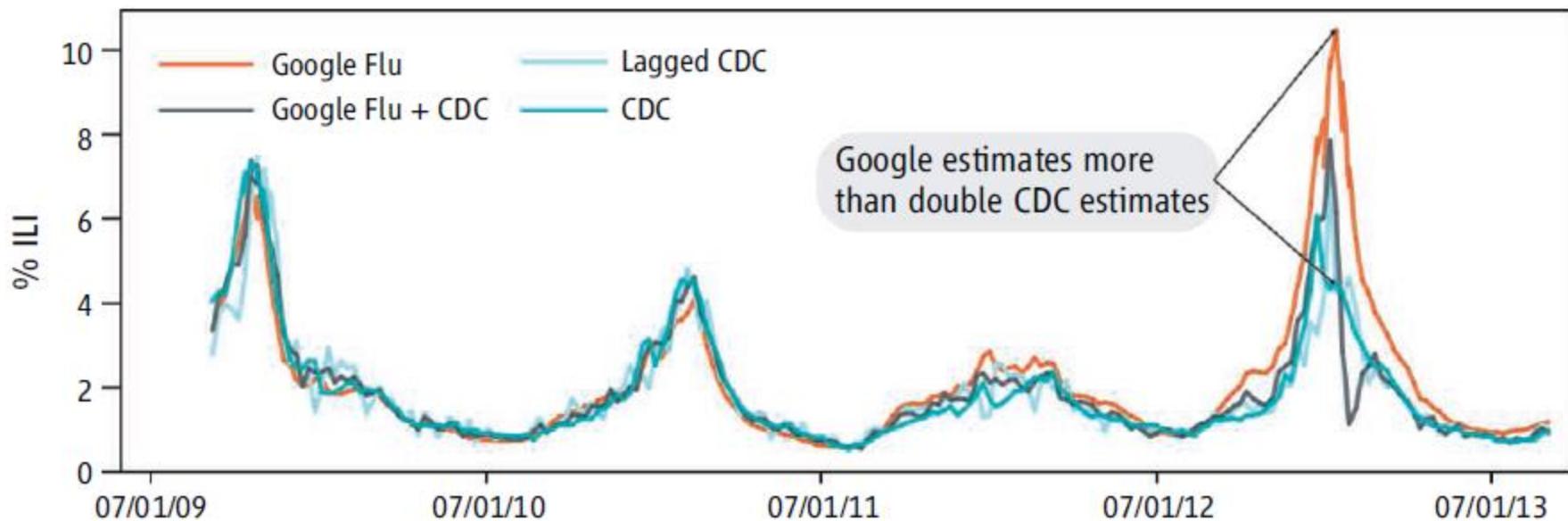
# Social Network and Obesity Prevalence



# The Parable of Google Flu: Traps in Big Data Analysis

14 MARCH 2014





# 의약품 안전관리를 위한 빅데이터의 활용

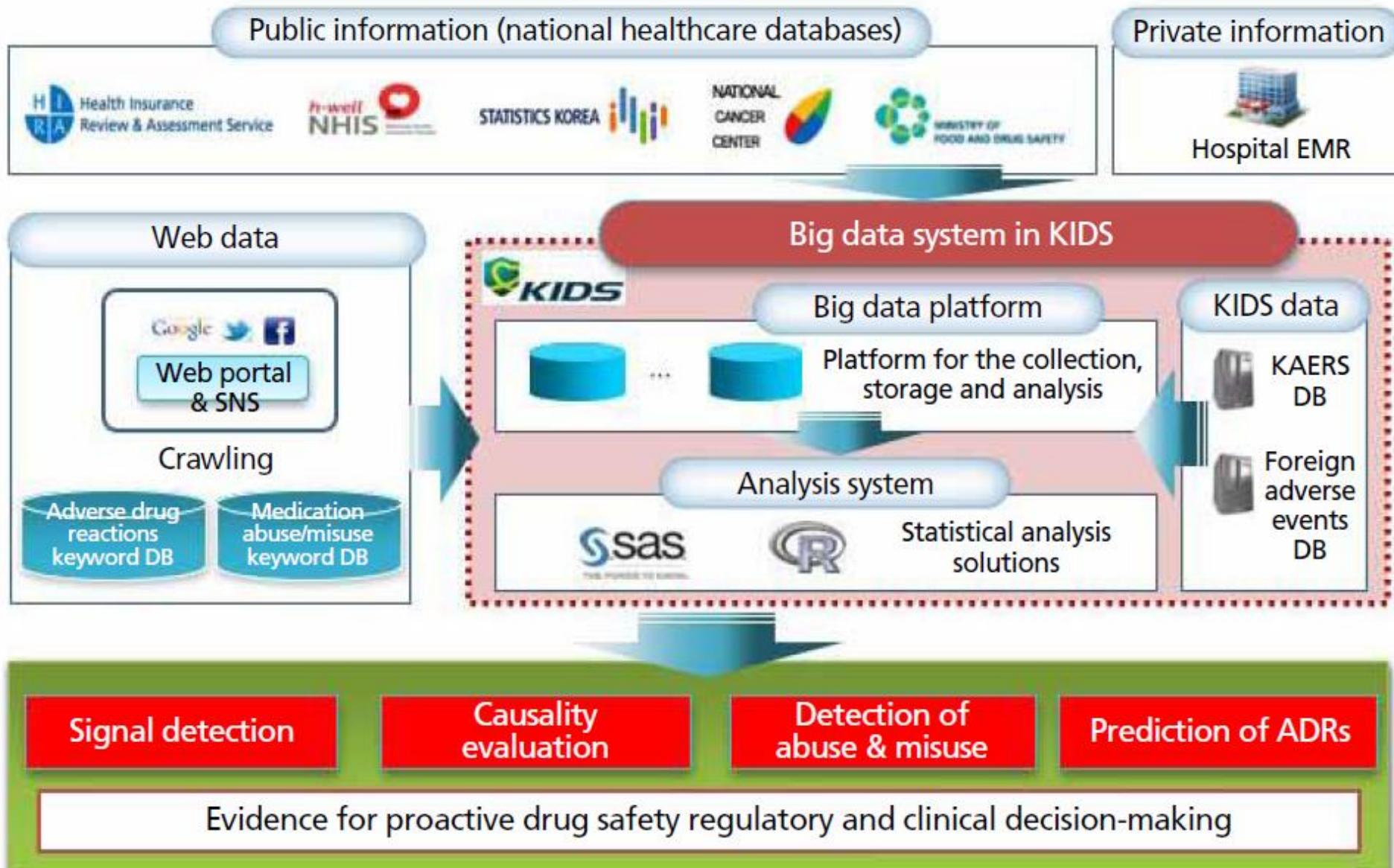
정선영<sup>1</sup> · 최남경<sup>2</sup> · 이중엽<sup>2</sup> · 박병주<sup>1,3</sup> | <sup>1</sup>한국의약품안전관리원 <sup>2</sup>서울대학교병원 의학연구협력센터, <sup>3</sup>서울대학교 의과대학 예방의학교실

## Use of big data for drug safety monitoring and decision making

Sun-Young Jung, PhD<sup>1</sup> · Nam-Kyong Choi, PhD<sup>2</sup> · Joongyub Lee, MD<sup>2</sup> · Byung-Joo Park, MD<sup>1,3</sup>

<sup>1</sup>Korea Institute of Drug Safety and Risk Management, Seoul, <sup>2</sup>Medical Research Collaborating Center, Seoul National University Hospital, <sup>3</sup>Department of Preventive Medicine, Seoul National University College of Medicine, Seoul, Korea

# Big data platform model by Korea Institute of Drug Safety and Risk Management



# Medical Big Data

As-Is



현재 환자모니터에서 기록되는  
로그성 데이터는  
단순히 수집만 되고 있으며,  
**활용이 되지 않음**

To-Be



저장된 데이터를 분석,  
심실부정맥 발병을 예측하여  
**중환자의 생존율 증가**

# Medical Big Data

As-Is

예상치못한  
신종독감 유행으로  
피해 발생해...



질병 확산 및 유행 시점에 대응 경보

To-Be

독감주의!



질병 발생 위험 징후를 탐지해 사전 대응

# Medical Big Data

As-Is



신고



조치

부작용의 지발적 신고에 의존하여

**부작용 판단 및 후속조치 지연**

To-Be



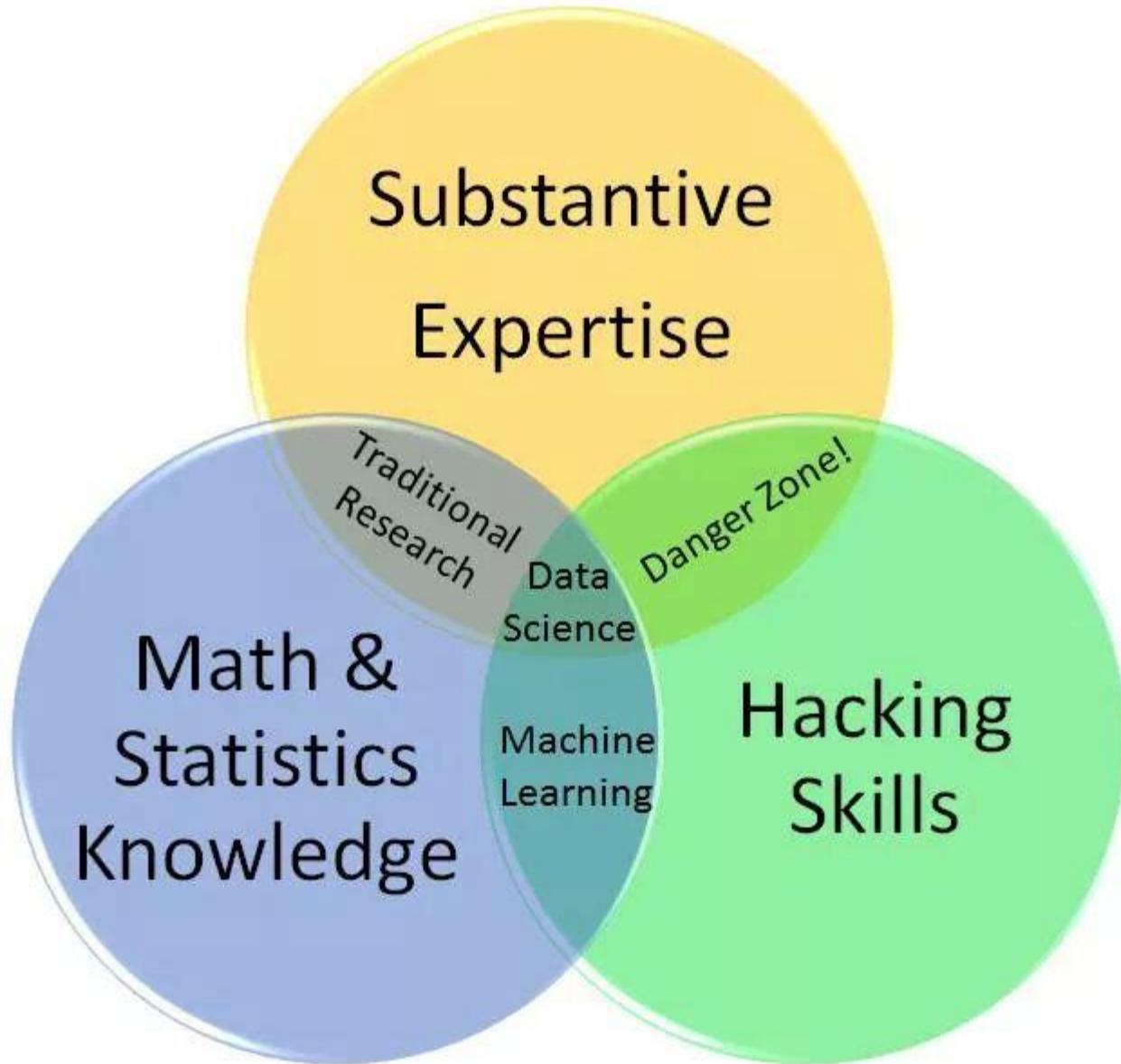
부작용 발생



**신속한 조치!**

자동 데이터 수집으로

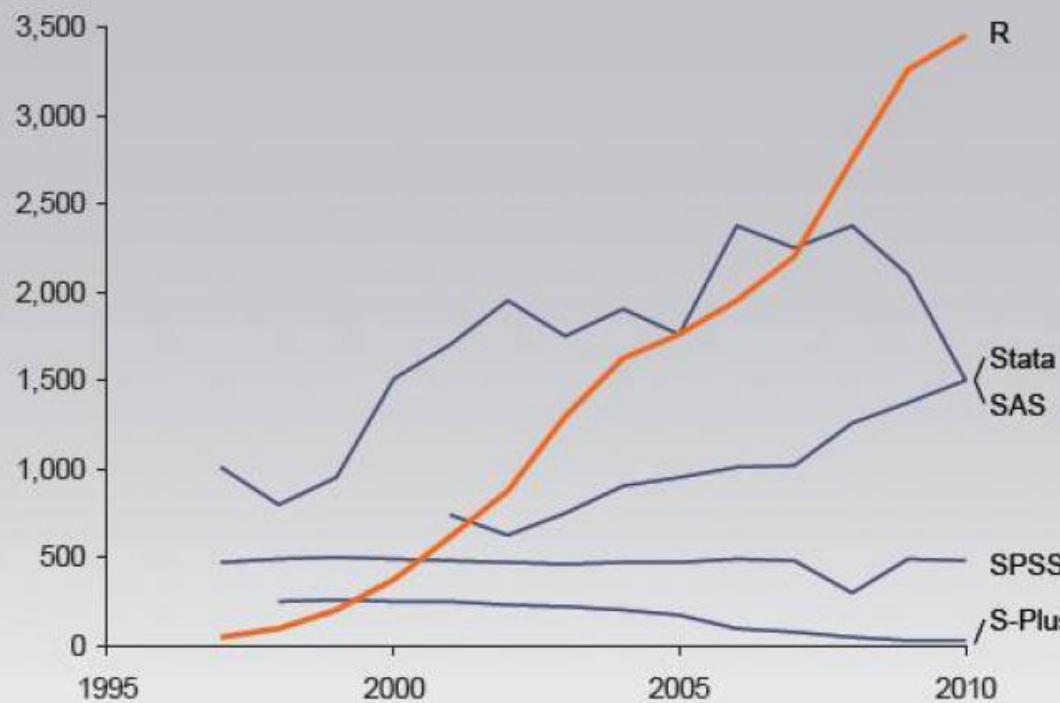
**부작용 발생 초기 대응**



# R vs. Stata vs. SAS

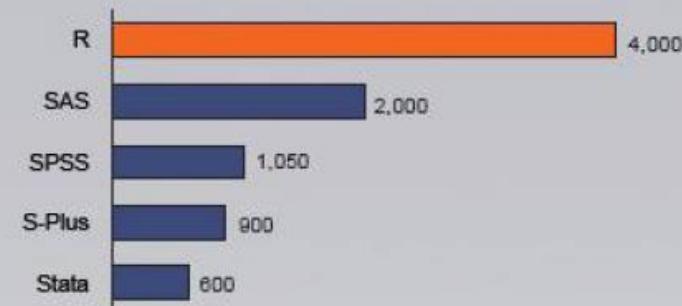
## Internet Discussion

Mean monthly traffic on email discussion list



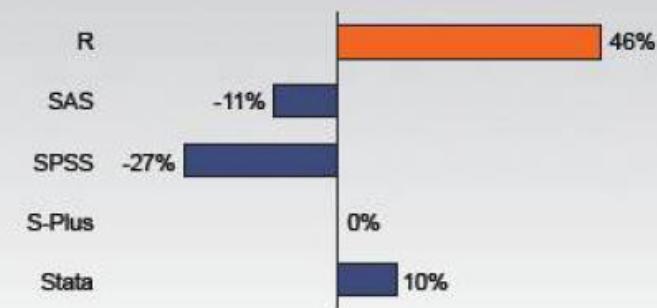
## Web Site Popularity

Number of links to main web site



## Scholarly Activity

Google Scholar hits ('05-'09 CAGR)



# 주요 통계 소프트웨어 특징 비교

특징	Stata	SPSS	SAS	R
학습 곡선	가파름/완만함	완만함/평坦함	매우 가파름	매우 가파름
사용자 환경	프로그래밍/마우스 클릭	대부분 마우스 클릭	프로그래밍	프로그래밍
데이터 관리	매우 강력	보통	매우 강력	매우 강력
데이터 분석	강력	강력	강력/만능	강력/만능
그래픽	매우 좋음	매우 좋음	좋음	탁월
비용	저렴(평생 라이선스, 업그레이드만 갱신)	고가(업그레이드까지 갱신 필요 없음, 장기간 라이센스)	고가(매년 갱신)	오픈 소스

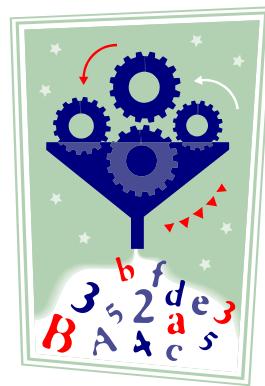
출처: Oscar Torres-Reyna, Getting Started in R~Stata Notes on Exploring Data  
<http://dss.princeton.edu/training/RStata.pdf>

# 빅데이터 연구 적용

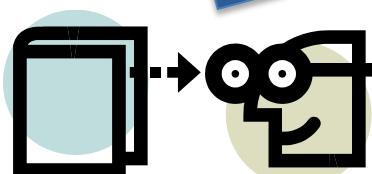
전통적인 관점 연구



Large scale  
(unstructured)  
data

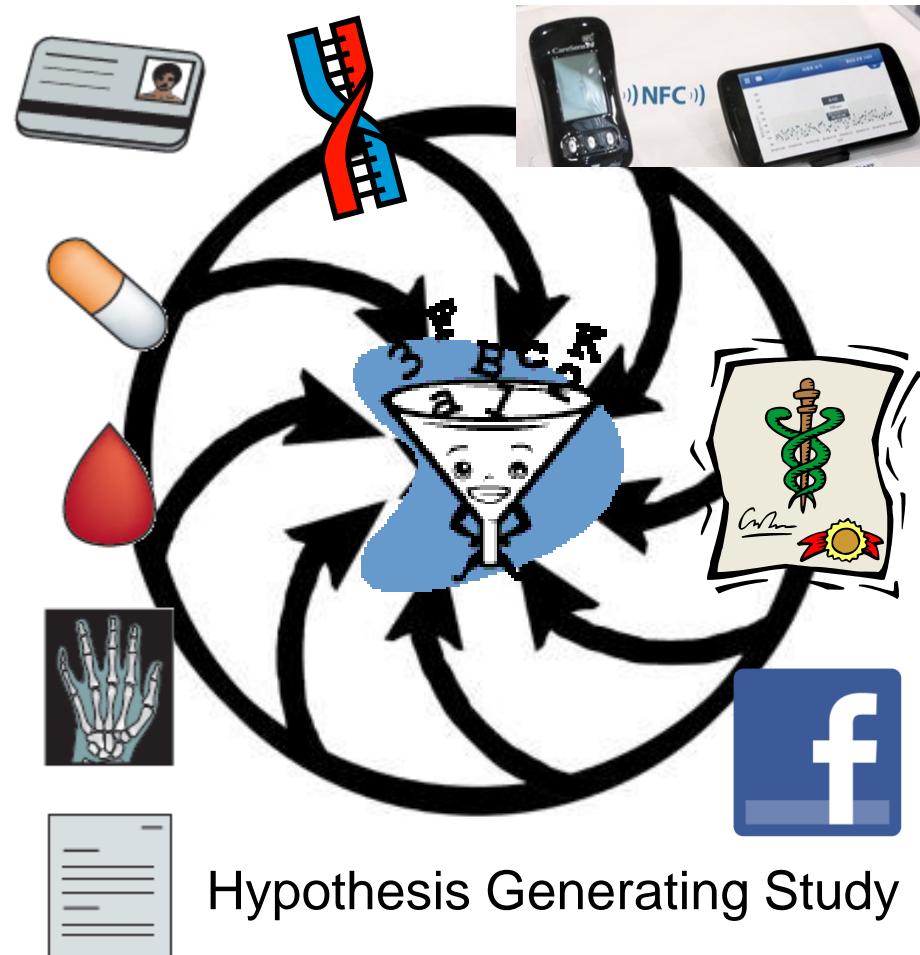


Summary  
(Modify)



Classical hypothesis driven study

새로운 관점 연구



Hypothesis Generating Study

# ANALYZE

