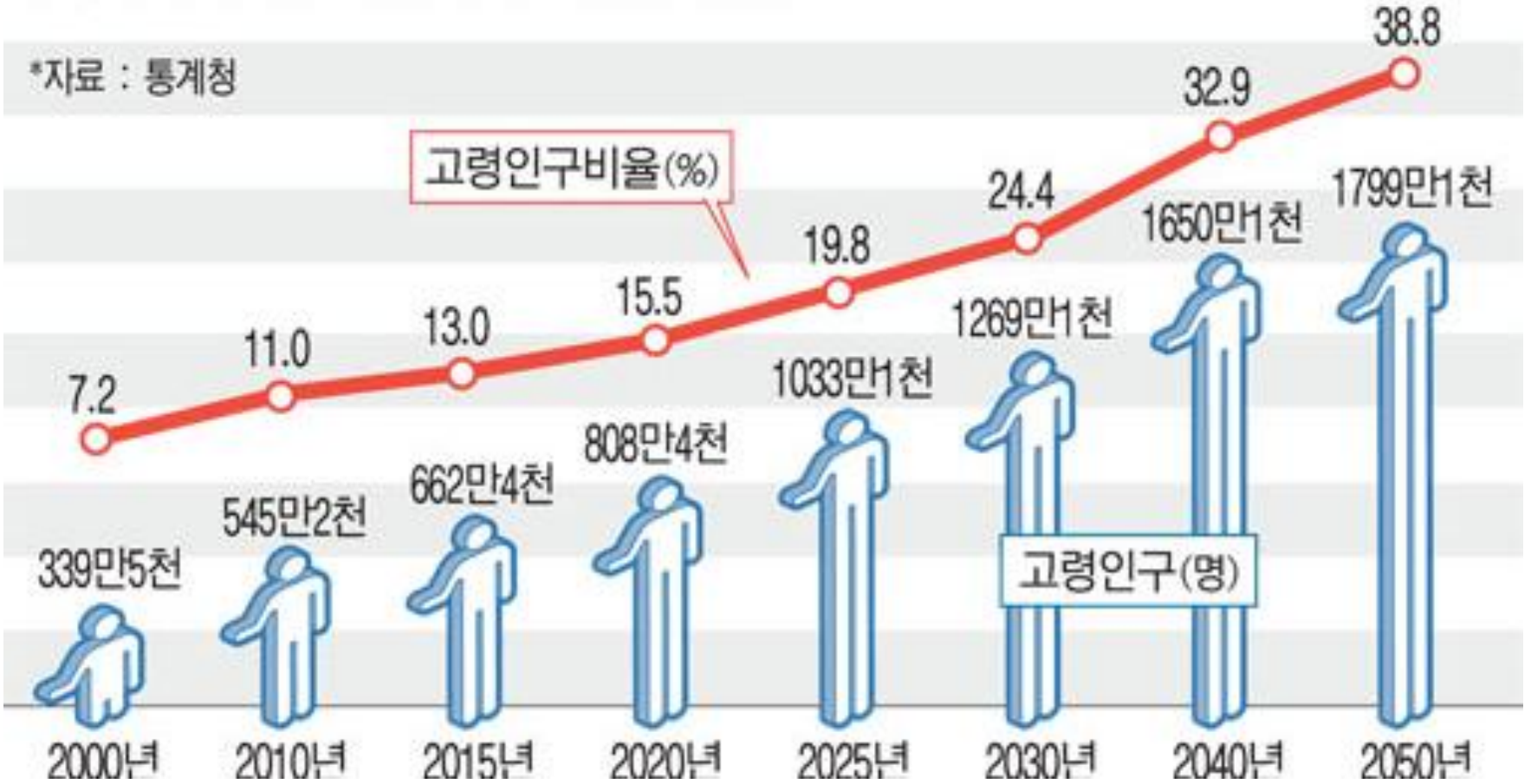
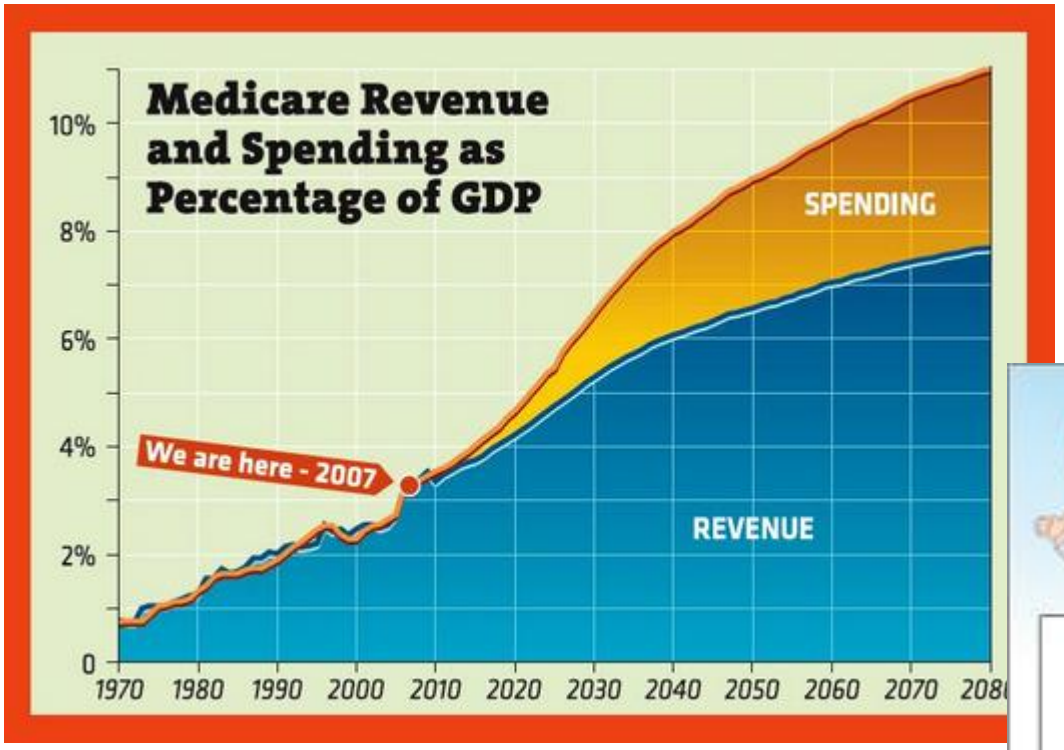
스마트 헬스케어

성균관의대 삼성서울병원
박 승 우

우리나라 인구고령화 추이 및 전망



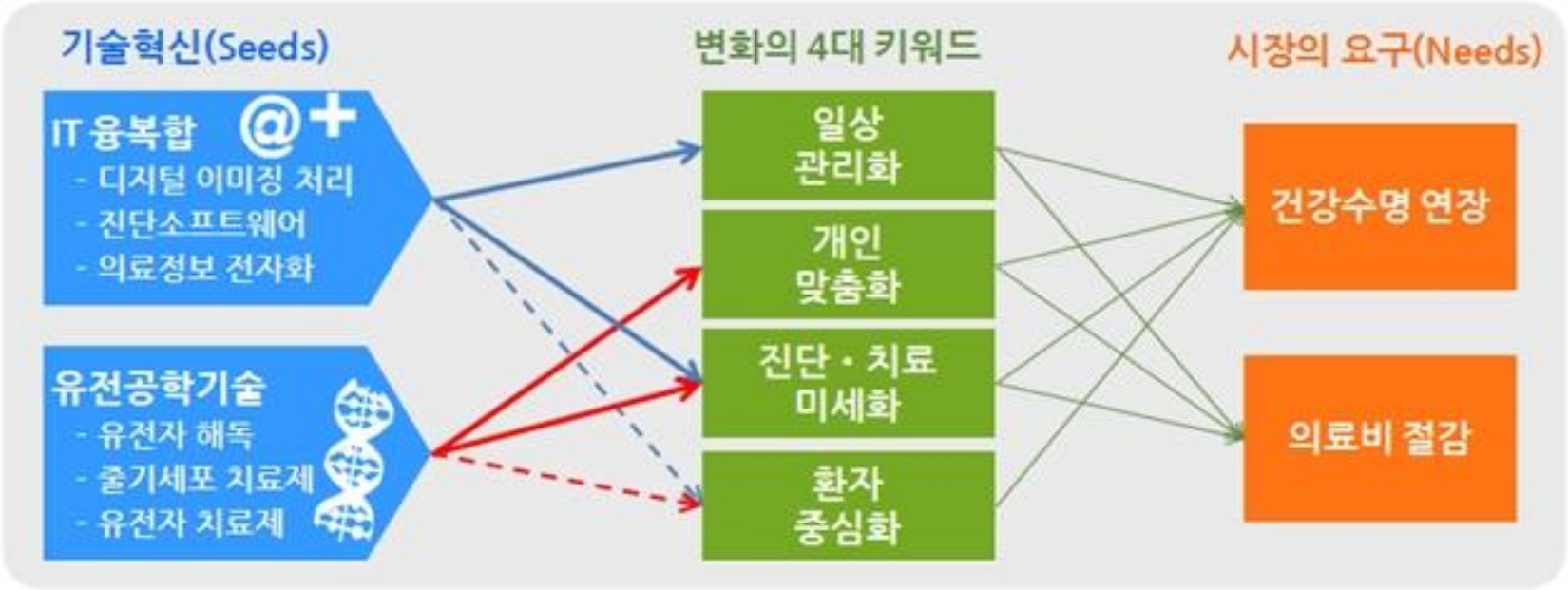
Cost Reduction



미국

Medicare 소비 예측

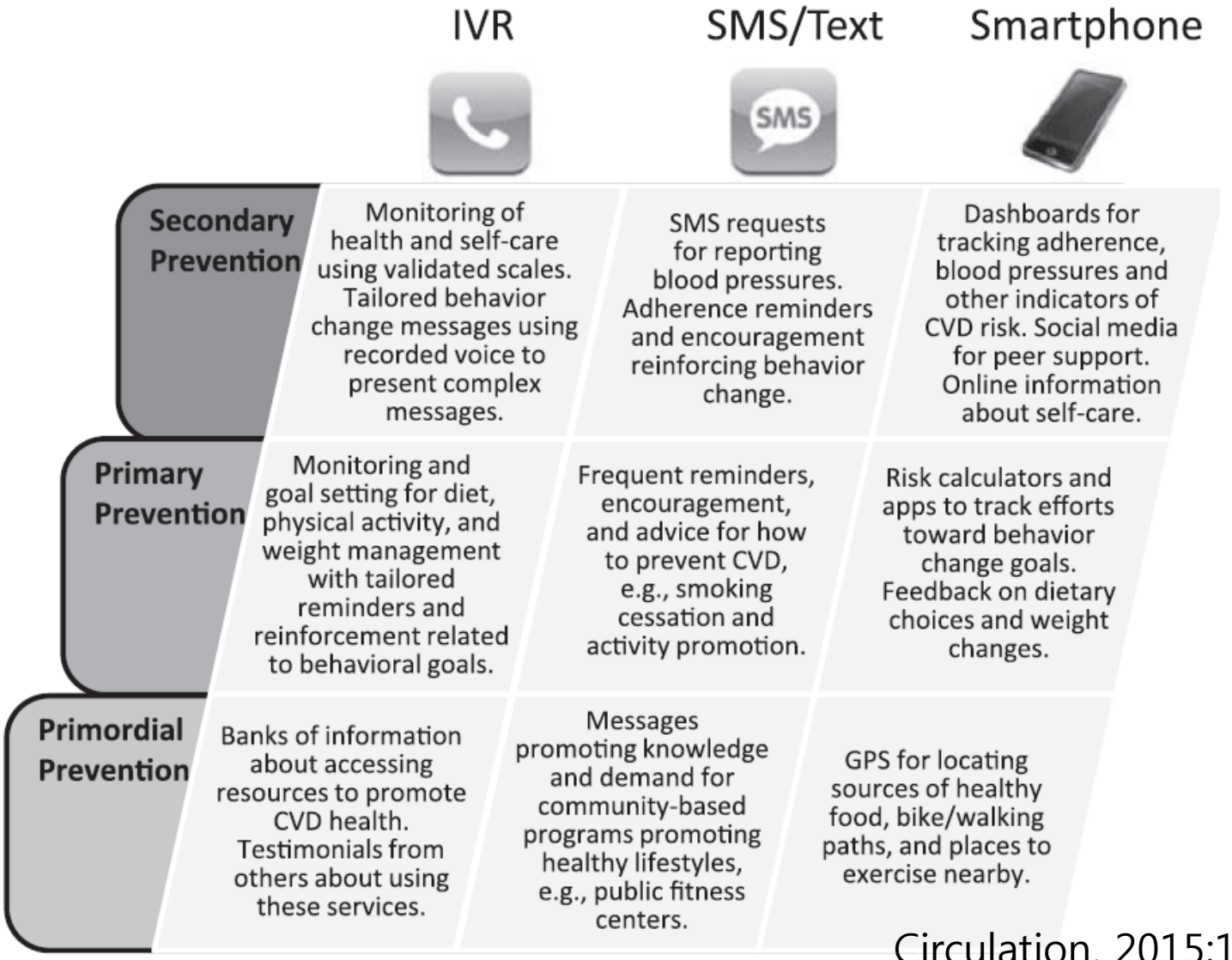
Healthcare 3.0



Development of IT Technology

- 손바닥 위의 강력한 컴퓨터
- 스마트폰에 탑재 가능해진 강력한 인공지능 (연산속도 - 딥블루 11.4 Gflops, 갤럭시 S6 34.8 Gflops)
- 스마트폰의 확산 –전 세계 인구의 60% 사용

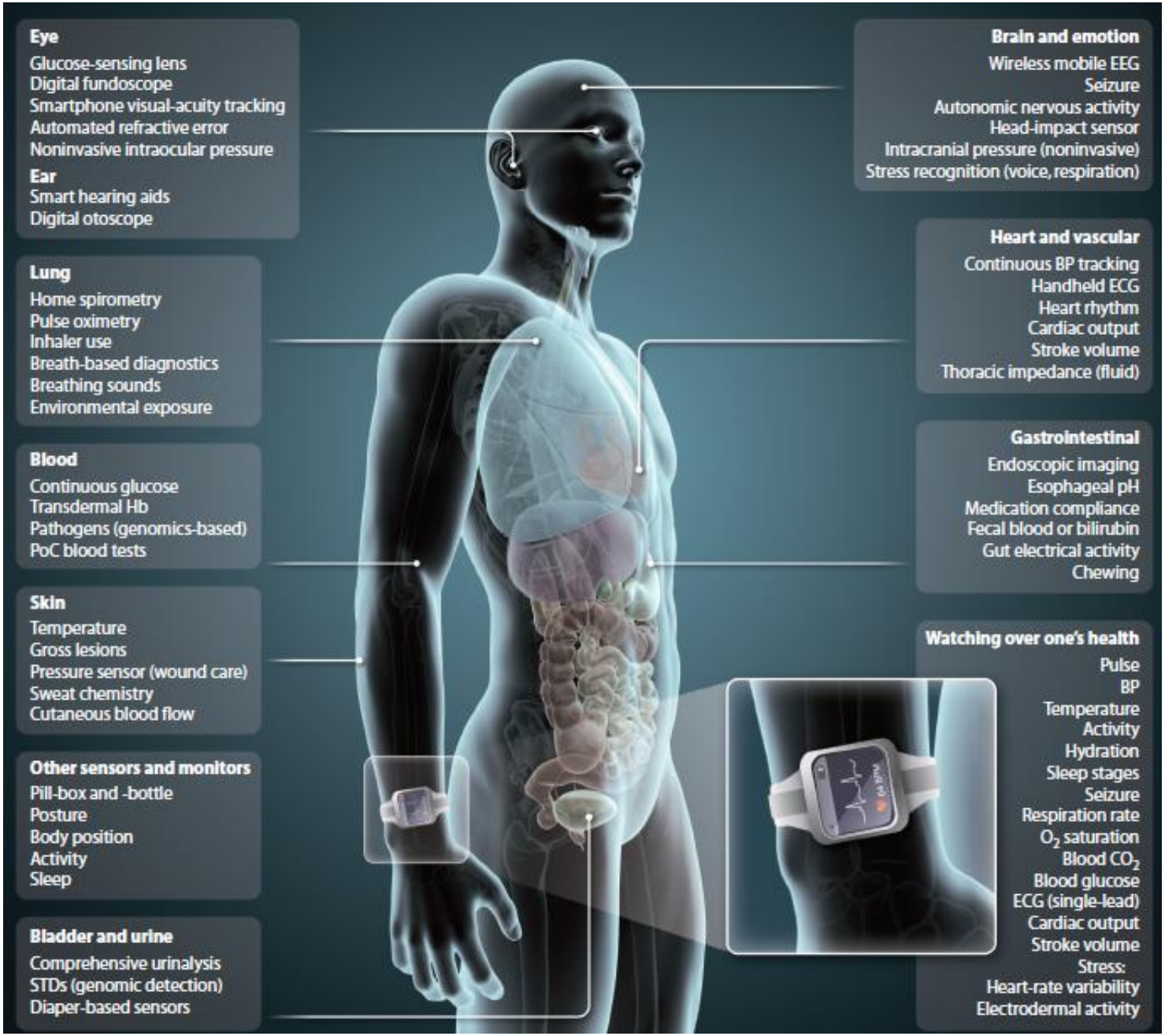
Teleservices targeting 3 levels of CVD prevention and management



Circulation. 2015;132:2012

Mobile healthcare의 확산 이유

- smartphone-linked wearable sensors
- point-of-need diagnostic devices
- medical-grade imaging
- real-time data streams
- automated clinical decision–support tools


Eye
Glucose-sensing lens
Digital fundoscope
Smartphone visual-acuity tracking
Automated refractive error
Noninvasive intraocular pressure
Ear
Smart hearing aids
Digital otoscope
Lung
Home spirometry
Pulse oximetry
Inhaler use
Breath-based diagnostics
Breathing sounds
Environmental exposure
Blood
Continuous glucose
Transdermal Hb
Pathogens (genomics-based)
PoC blood tests
Skin
Temperature
Gross lesions
Pressure sensor (wound care)
Sweat chemistry
Cutaneous blood flow
Other sensors and monitors
Pill-box and -bottle
Posture
Body position
Activity
Sleep
Bladder and urine
Comprehensive urinalysis
STDs (genomic detection)
Diaper-based sensors
Brain and emotion
Wireless mobile EEG
Seizure
Autonomic nervous activity
Head-impact sensor
Intracranial pressure (noninvasive)
Stress recognition (voice, respiration)
Heart and vascular
Continuous BP tracking
Handheld ECG
Heart rhythm
Cardiac output
Stroke volume
Thoracic impedance (fluid)
Gastrointestinal
Endoscopic imaging
Esophageal pH
Medication compliance
Fecal blood or bilirubin
Gut electrical activity
Chewing
Watching over one's health
Pulse
BP
Temperature
Activity
Hydration
Sleep stages
Seizure
Respiration rate
O_2 saturation
Blood CO_2
Blood glucose
ECG (single-lead)
Cardiac output
Stroke volume
Stress:
Heart-rate variability
Electrodermal activity

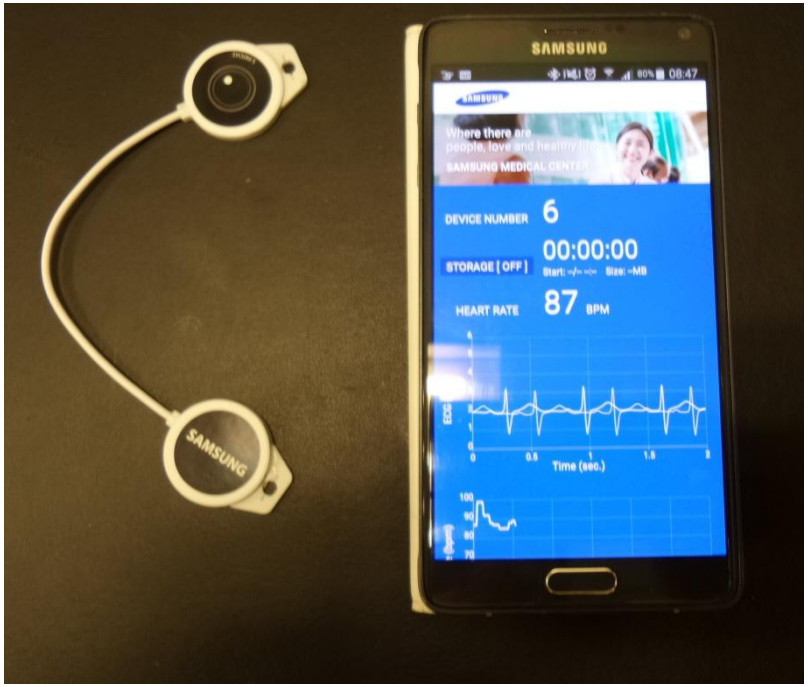
Wearable Sensors

- Bracelets
- Watches
- skin patches
- headbands
- Earphones
- clothing

Ideal Wearable Sensors

- unobtrusive
- passive
- continuous monitoring if necessary
- ability to seamlessly track and transfer all biometric data


SAMSUNG
S-PATCH2
HobbyKing
MODEL 500
8.3
MAX=500g
d=0.1g
ON/OFF
MODE
TARE


SAMSUNG
SAMSUNG
Where there are
people, love and healthy life
SAMSUNG MEDICAL CENTER
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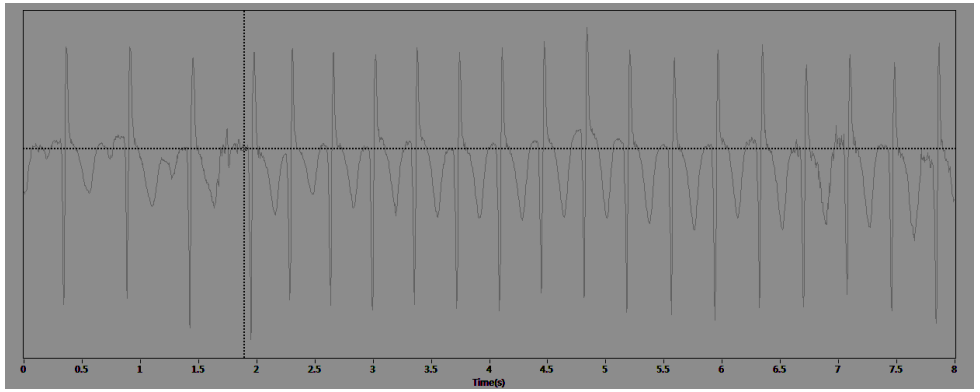
6
00:00:00
STORAGE [OFF]
HEART RATE
87
BPM
ECG
Time (sec.)
SAMSUNG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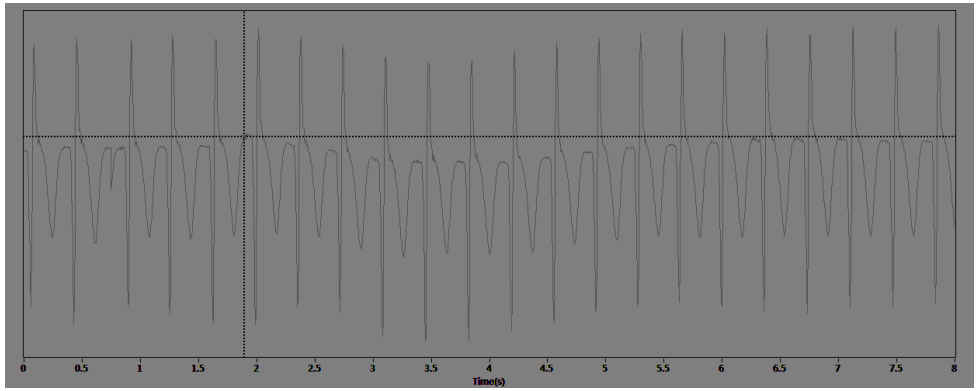
Time(s)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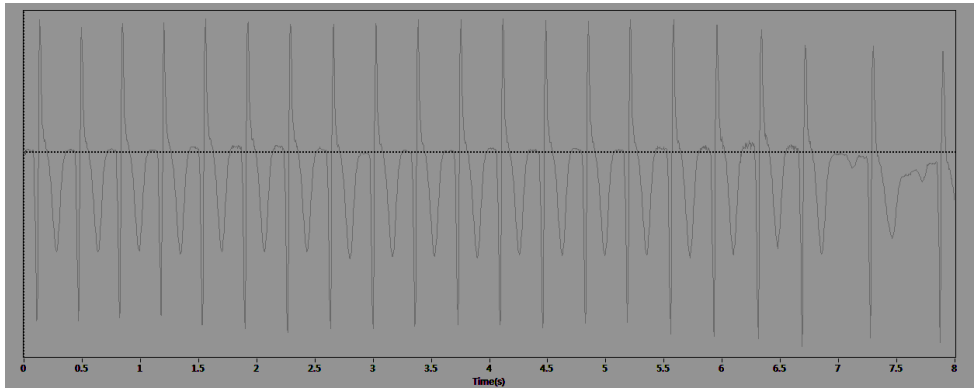
Time(s)


0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5 8
Time(s)

German group data of bioimpedance

25 patients of decompensation heart failure
- Mean age of 73.8 years
- Mean body mass index 28.6

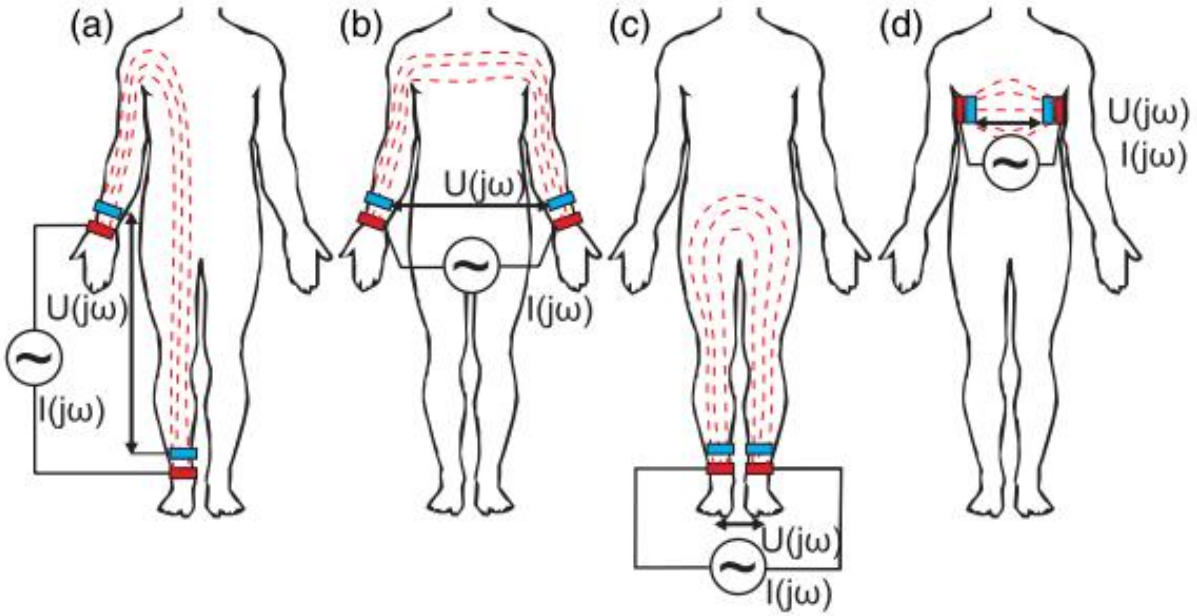
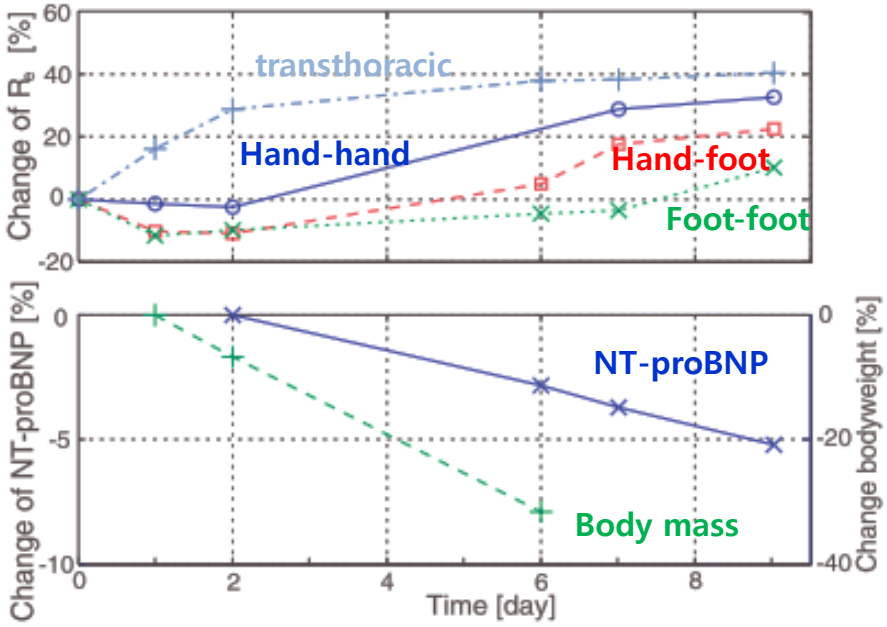


Figure 1. Placement of the current- and voltage measurement electrodes: (a) hand to foot, (b) hand to hand, (c) foot to foot and (d) thorax.

Physiol. Meas. 35 (2014) 917–930

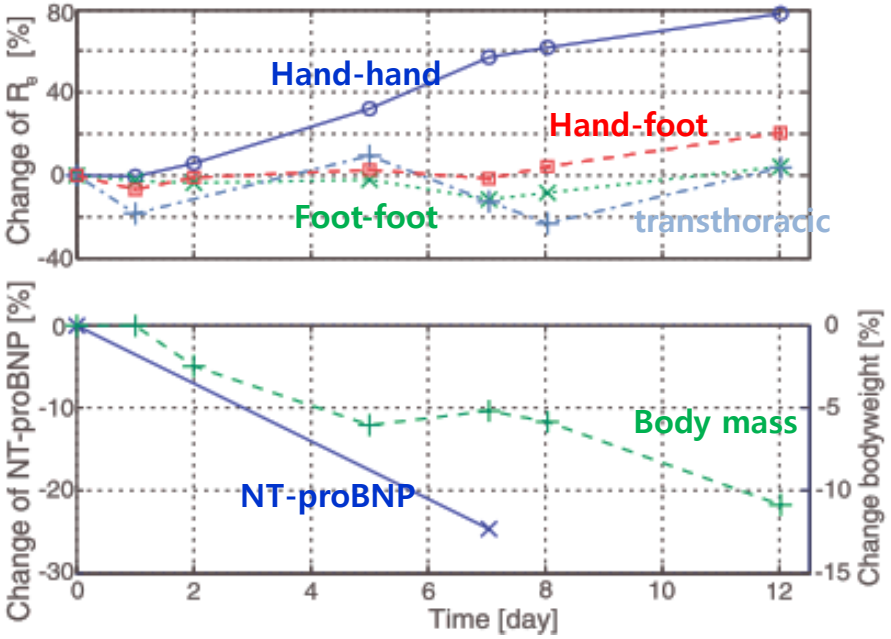
Change in bioimpedance and NT-proBNP
- Typical cases -

A case of left heart failure



Re: Extracellular resistance

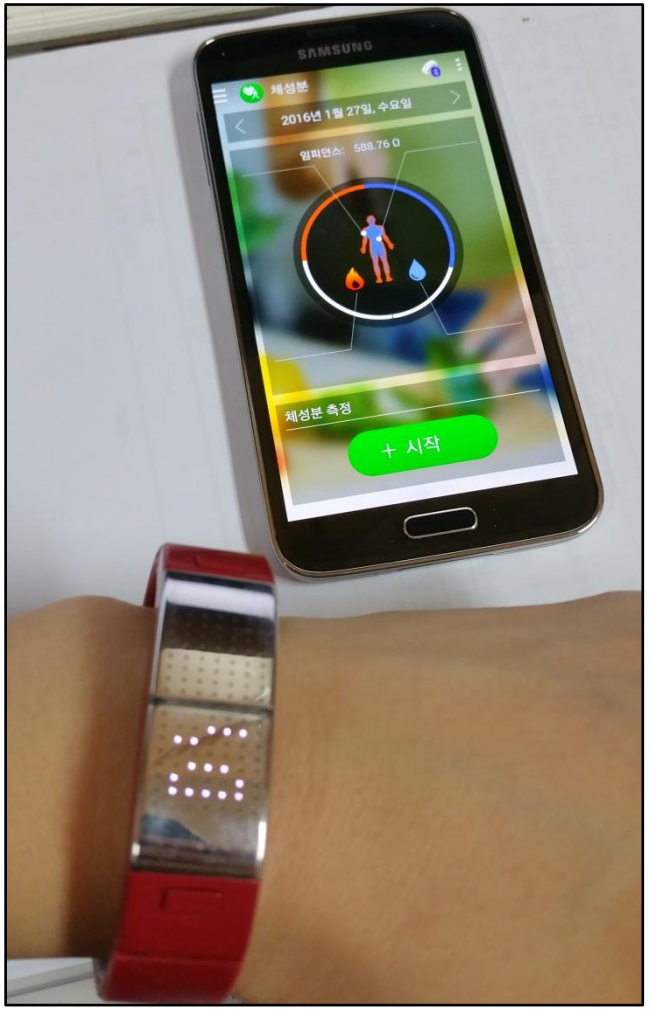
A case of right heart failure



Physiol. Meas. 35 (2014) 917–930

SMC Experiences

- Measuring bioimpedance in acute decompensated heart failure patients who need hospitalization
- hand-to-hand



Case

M/77,

HTN/DM (-/-),
COPD, Bronchiectasis on mucolytics and inhaler

2WA pitting edema developed

1DA dyspnea and orthopnea aggravated sputum

SMC ER visited

V/S: 109/61-104-36.9-19
SpO2 95% at RA

Lab: CBC 11950-13.6-421K, CRP 9.7
T-B 0.6, AST/ALT 19/9,
BUN/Cr 10.9/1.09, e- 137-4.0-98
NT-proBNP 11035, BNP 3170

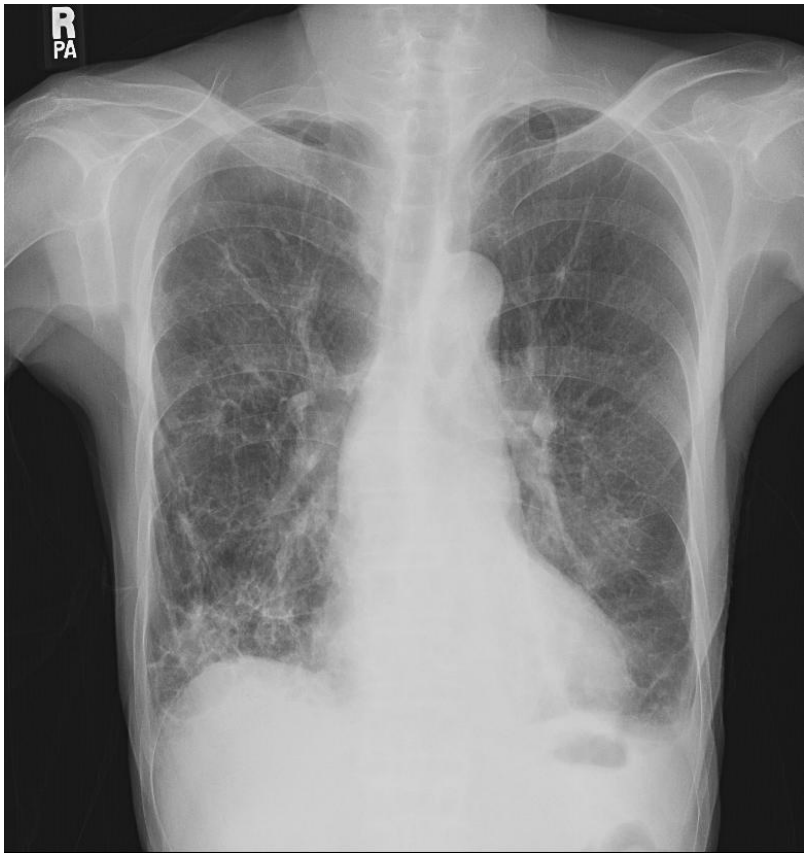
Impedance 381.7 Ω at HD2

Case

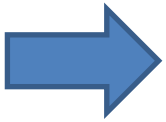
- Echocardiography
  - HR 78
  - Severe LV systolic dysfunction (LVEF 27.3% by Simpson's method)
  - LV dilatation (LVIDd/s 64/55mm)
  - Dilated ascending aorta (42.7mm)
  - Mild AR

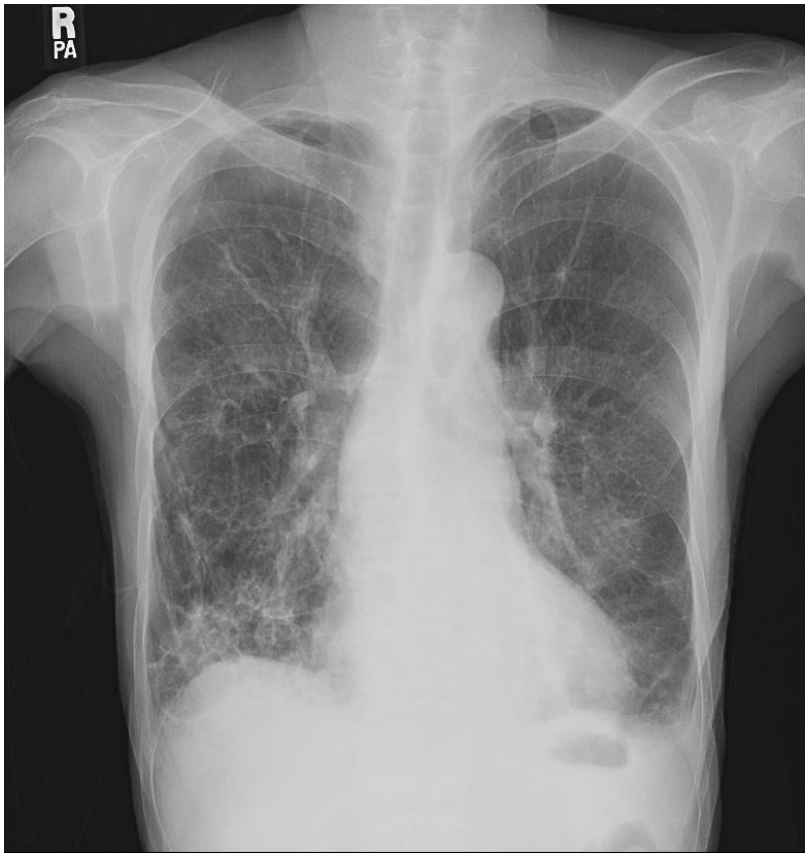
Case

- Hospital day 14
- No orthopnea, pitting (-)
- Bwt 44.5kg at HD2 → 41.5kg
- Impedance 653.4 Ω
- Amiodarone 200mg qd, furo 20mg qd, spiro 25mg qd, meropenem for pneumonia
- V/S: 101/62-77-18-36.3




R UP




R
PA

Sensor technologies

- 심전도 – one lead, 3 leads, 12 leads
- 혈압 – photoplethysmography (광학적으로 조직내 미세혈관의 혈액변화량의 측정)와 pulse transition time
- 자율신경계 – HRV, eletrodermal metrics
- 기타 – 수면 감시, 컨택트 렌즈를 이용한 눈물 glucose 측정

New Drugs and Technologies

Novel Wireless Devices for Cardiac Monitoring

Joseph A. Walsh III, MD, MS; Eric J. Topol, MD; Steven R. Steinhubl, MD

Circulation. 2014;130:573-581

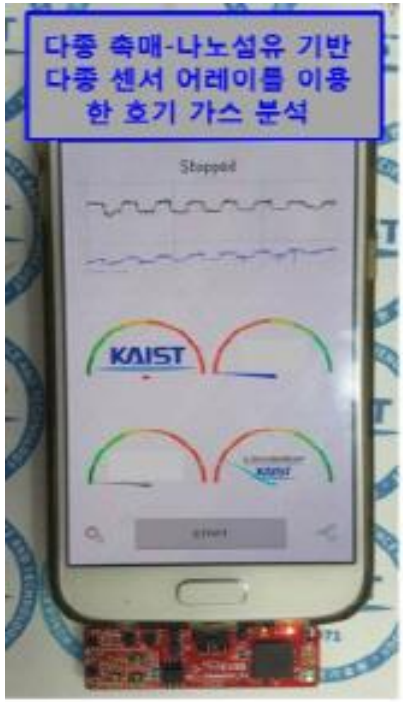
Name	Company	Link	Brief Description
Comprehensive vital sign monitoring			
VitalSigns Camera	Phillips	http://www.vitalsignscamera.com/index.html	Skin microblush change in capillary filling to measure heart rate and chest movement to measure respiratory rate
Scout	Scanadu	http://www.scanadu.com/	Measures temperature, pulse, oximetry, ECG, heart rate variability, and pulse wave transit time
BioPatch	Zephyr	http://www.zephyranywhere.com/healthcare/biopatch/	Adhesive patch transmits wirelessly pulse, R-R interval, respiratory rate, activity, respirations, ECG, position, and posture
Hexoskin	Hexoskin Wearable Body Metrics	http://www.hexoskin.com/en?utm_campaign=Listly&utm_medium=list&utm_source=listly	Shirt measures heart rate, heart rate variability, respiratory rate and volume, and activity; also estimates $\dot{V}O_2max$
OMSignal	OMSignal	http://www.omsignal.com/	Washable shirt that monitors 3-lead ECG, respirations, stress, and temperature
Sensor Bra	Microsoft	http://www.cs.rochester.edu/hci/pubs/pdfs/FoodMood.pdf	Sensors built into bra: heart rate, respiration, Electrodermal activity; 3-axis accelerometer; 2-axis gyroscope; designed to track emotions and study emotional eating
Intermittent ECG			
Alivecor System	Alivecor	http://www.alivecor.com/	With application able to analyze and print ECGs as PDFs; ECG data sync between the application and online ECG hub; prescription only
ECG Check	CardiacDesigns	http://cardiacdesigns.com/	With application able to analyze and print ECGs as PDFs; ECG data sync between the application and online ECG hub
EPI Mini (also EPI Life)	EPI Mobile Health Solutions	http://epimhealth.com.sg/	Separate device that transmits ECG to smartphone, which can forward it to a "health concierge" service that can send back a reading; cleared by the US Food and Drug Administration for consumer use
12-Lead ECG	MobilECG	http://mobilecg.hu/	USB-based open-source 12-lead clinical ECG

Name	Company	Link	Brief Description
Prolonged ECG monitoring			
eMotion ECG Mobile	Mega Electronics	http://www.megaemg.com/	3-Lead ECG data are transmitted from the wearable etooth; the phone forwards the data over mobile network to a server, which stores the data;. the data can be monitored in real time or a specialist can investigate and analyze the stored ECG data
BodyGuardian	Preventice	http://www.preventice.com/	Patch monitor of ECG, activity, respirations, and body position
Zio XT Patch	iRhythm	http://www.irhythmtech.com/?utm_campaign=Listly&utm_medium=list&utm_source=listly	14-d continuous cardiac rhythm monitoring with a single adhesive chest wall device; once completed, it is mailed for analysis
NUVANT Mobile Cardiac Telemetry System	Corventis	http://www.corventis.com/	Automatic and patient-triggered 30-d cardiac rhythm monitoring; arrhythmia detection: the device transmits information via a wireless data transmission device, zLink, to the Corventis Monitoring Center
Ambulatory ECG	iHealth	http://ces.cnet.com/8301-35284_1-57616620/at-ces-2014-health-monitors-join-the-wearables-parade/	Sensor attaches to chest and transmits ECG to smartphone
Heart failure			
CoVa necklace	Perminova	http://www.perminova.com/sensor/	Measures heart rate, respiratory rate, fluid levels
VitaLink	vg-bio	http://www.vgbio.com/vitalink-remote-patient-monitoring/	Measures pulse, heart rate variability, transthoracic impedance, and activity via head band and chest strap
AVIVO Mobile Patient Monitoring System	Corventis	http://corventis.com/us/avivo.asp	Monitors thoracic impedance, heart rate, heart rate variability, respiration rate, posture, and heart rhythm with wireless transmission to the Corventis Monitoring Center
Telescale	Cardiocom	http://www.cardiocom.com/telescale.asp	For daily weights with automated verbal/feedback and communication to the patient and provider

Name	Company	Link	Brief Description
Blood pressure			
ViSi Mobile	Sotera Wireless	http://www.visimobile.com	Wireless vital sign monitoring with noninvasive continuous blood pressure monitor
Wireless wrist blood pressure monitor	iHealth	http://www.ihealthlabs.com/wireless-blood-pressure-wrist-monitor-feature_33.htm	Wireless wrist blood pressure measurement and heart rate transmitted to a mobile application
iPhone-connected blood pressure cuff	Withings	http://www.withings.com/bloodpressuremonitor	Plugs into iPhone or iPad and tracks and displays all results; also available in 2014 with Bluetooth connection between the cuff and smartphone
Continuous blood pressure watch	Quanttus	http://www.technologyreview.com/news/524376/this-fitness-wristband-wants-to-play-doctor/	Continuous monitoring of blood pressure, heart rate, and respirations.
BPro radial artery pressure monitor	HealthStats	http://www.healthstats.com	Watch-like device that samples radial artery waveforms via tonometry at regular time intervals over a 24-h period; for assessment of ambulatory blood pressure
Wearable, wireless ambulatory blood pressure monitor	iHealth	http://ces.cnet.com/8301-35284_1-57616620/at-ces-2014-health-monitors-join-the-wearables-parade/	Vest-like device that allows blood pressure to be measured as frequently as every 15 min throughout the day
Ultrasound			
VScan	GE	http://www3.gehealthcare.com/en/Products/Categories/Ultrasound/Vscan	Standalone ultrasound imaging device that can download ant transmit images
MobiUS SPI	Mobisante	http://www.mobisante.com/product-overview/	Smartphone-based ultrasound
Terason USmart 3200T	Terason	http://www.terason.com/index.asp	Comprehensive ultrasound
Nanomaxx	Sonosite	http://www.sonosite.com/products/nanomaxx	Standalone ultrasound imaging device that can download and transmit images.

Lab on a Chip

- Power and connectivity by smartphones
- A combination of microfluidics (requiring just nano or picoliter volumes of fluid) and microelectronics allows for the “digitization” of sweat, blood, saliva, urine, tears, and breath
- Accessible virtually anywhere, anytime
- E-nose for VOC (volatile organic compounds) from cancer, infection, pharmacogenetics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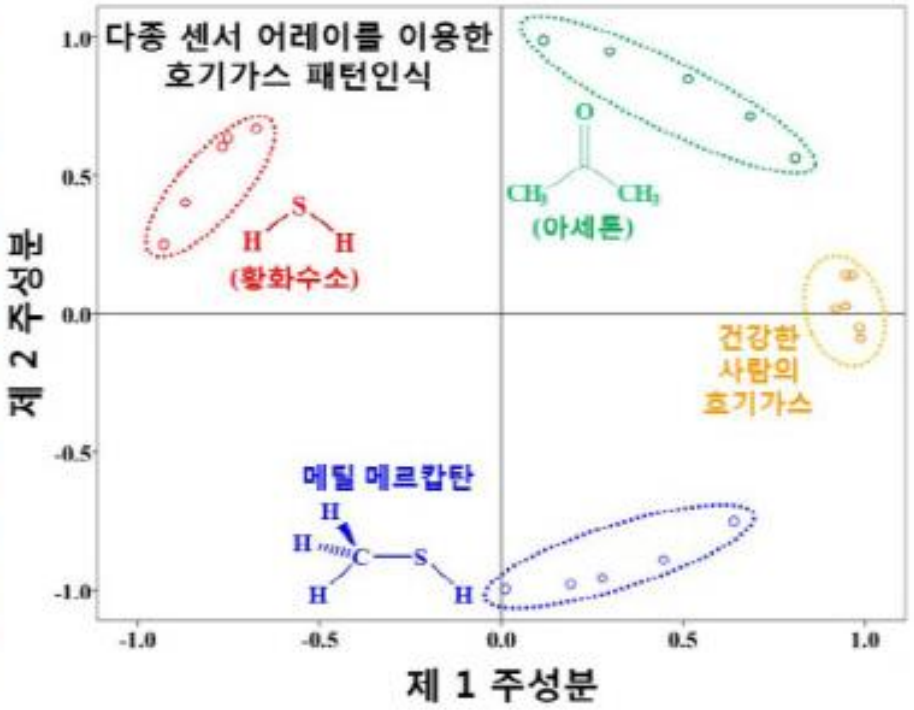
한 호기 가스 분석
Stopped
KAIST


다종 센서 어레이를 이용한
호기가스 패턴인식
(황화수소)
(아세톤)
건강한
사람의
호기가스
메틸 메르캅탄
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제 1 주성분
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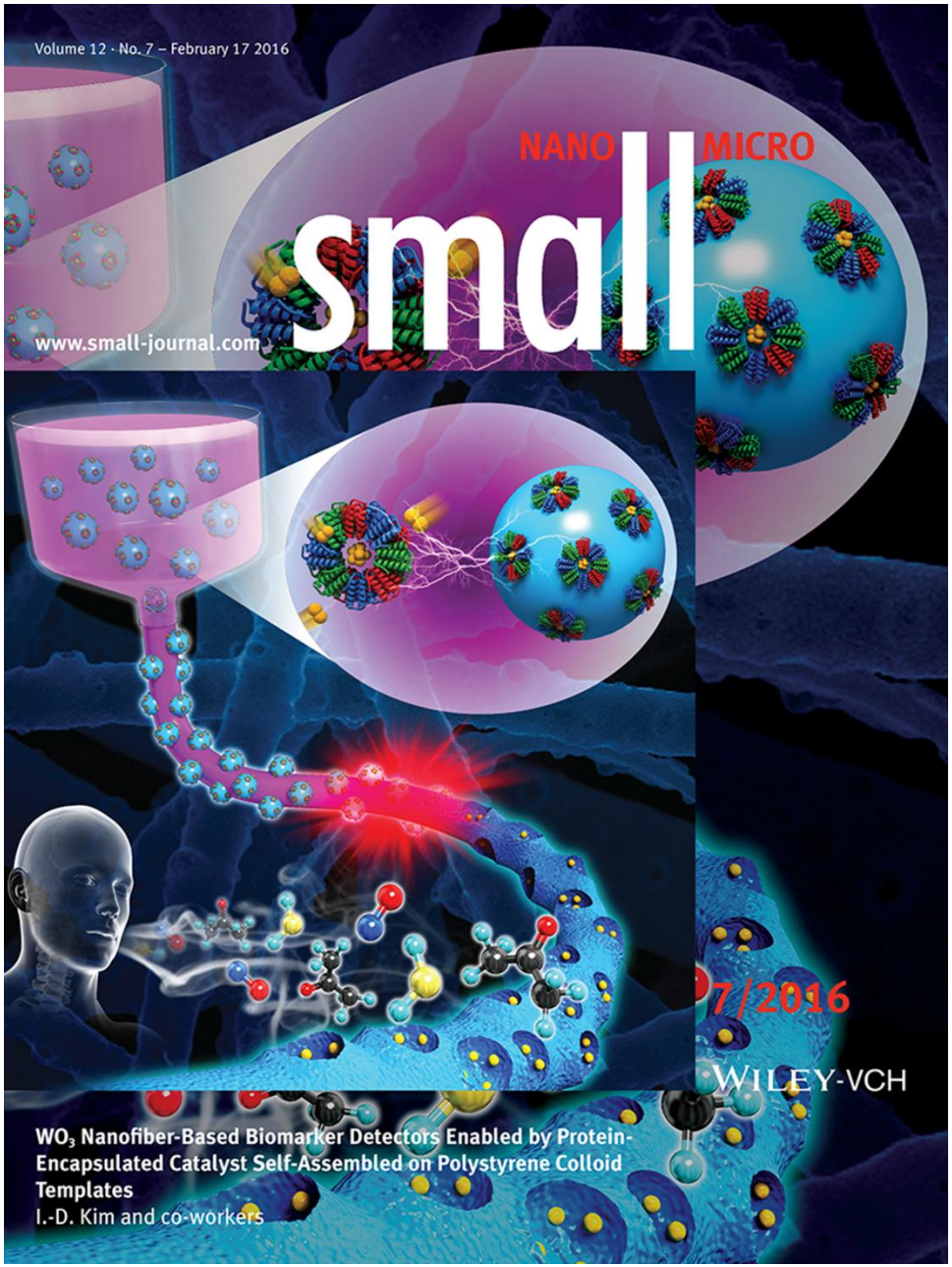
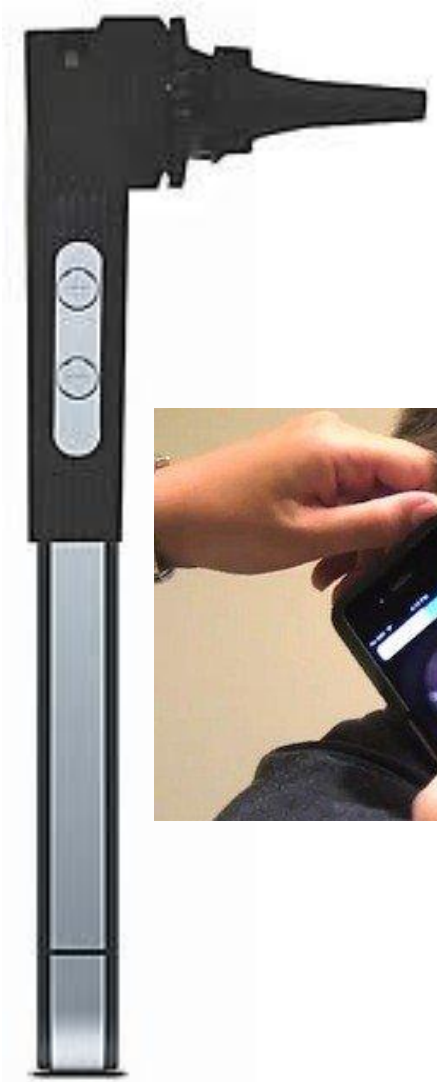
-1.0

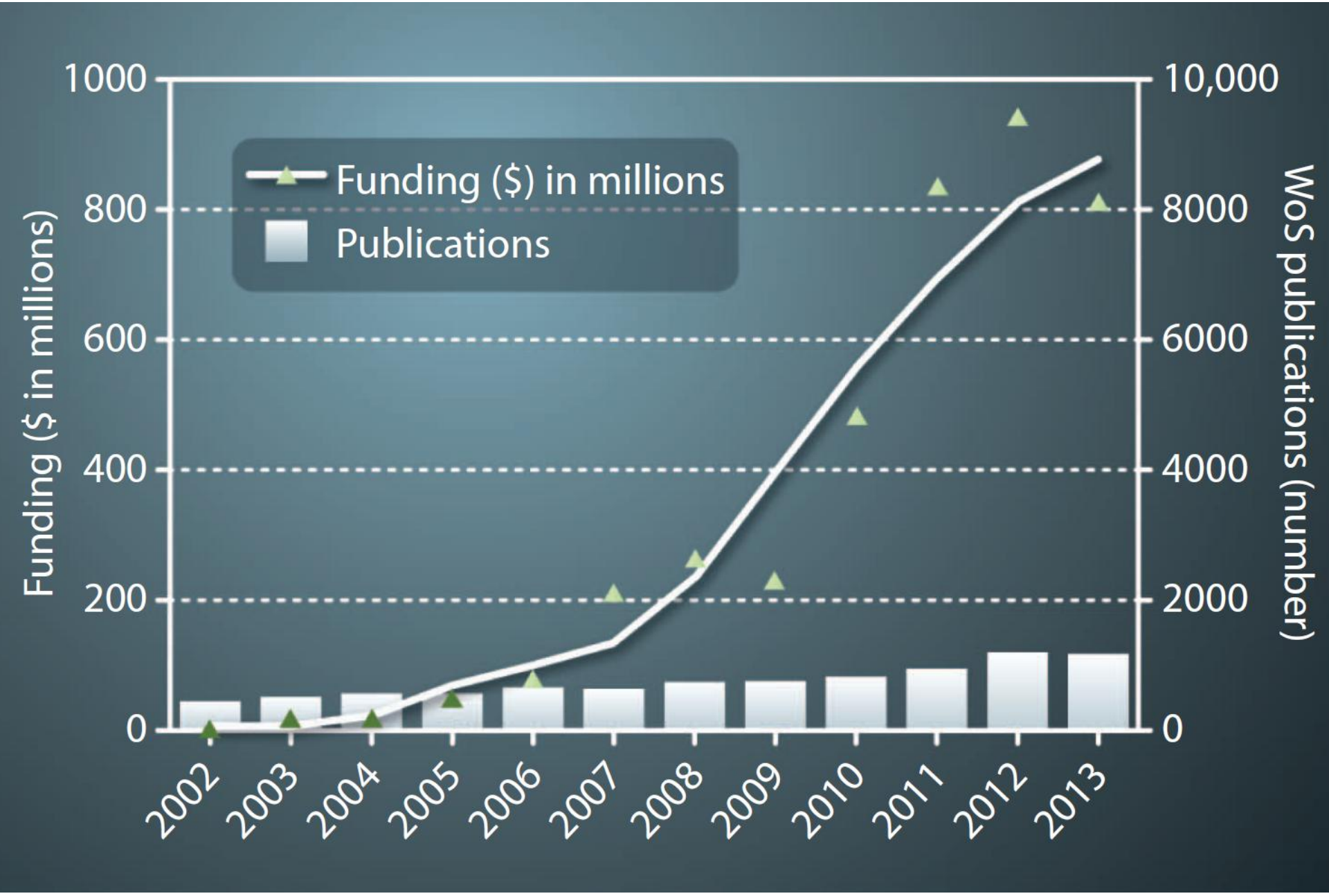

Volume 12 · No. 7 – February 17 2016
NANO
small
MICRO
www.small-journal.com
7/2016
WILEY-VCH
WO3 Nanofiber-Based Biomarker Detectors Enabled by Protein-Encapsulated Catalyst Self-Assembled on Polystyrene Colloid Templates
I.-D. Kim and co-workers

Imaging from Afar

- High quality of the camera lenses and screen resolution of smartphones for medical apps, from photometric diagnostics to medical-grade imaging
- Transportable imaging capability involves the enabling of remote diagnosis – ex) teledermatology, ophthalmoscope, otosc ope, colposcope, etc.


SAMSUNG




Funding ($) in millions
Publications
Funding ($ in millions)
WoS publications (number)
1000
800
600
400
200
0
10,000
8000
6000
4000
2000
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

A prospective randomized trial examining health care utilization in individuals using multiple smartphone-enabled biosensors

Cinnamon S. Bloss[1,*], Nathan E. Wineinger[1,*], Melissa Peters[1], Debra L. Boeldt[1], Lauren Ariniello[1], Ju Young Kim[2], Judith Sheard[1], Ravi Komatireddy[1], Paddy Barrett[1] and Eric J. Topol[1,3,4]

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[2] Department of Family Medicine, Seoul National University Bundang Hospital, Seoul, South Korea
[3] Department of Molecular and Experimental Medicine, The Scripps Research Institute, La Jolla, United States
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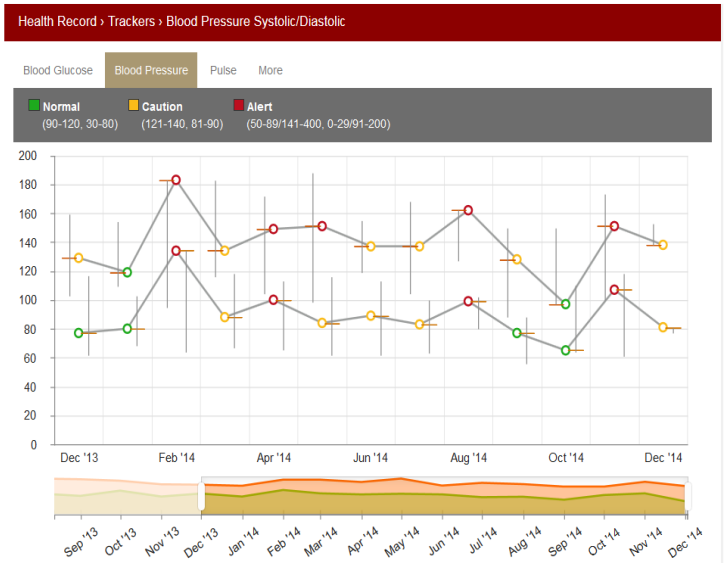
* These authors contributed equally to this work.

PeerJ 4:e1554; DOI 10.7717/peerj.1554, 2016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Blood Glucose
Blood Pressure
Pulse
More
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(90-120, 30-80)
Caution
(121-140, 81-90)
Alert
(50-89/141-400, 0-29/91-200)
200
180
160
140
120
100
80
60
40
20
0
Dec '13
Feb '14
Apr '14
Jun '14
Aug '14
Oct '14
Dec '14
Sep '13
Oct '13
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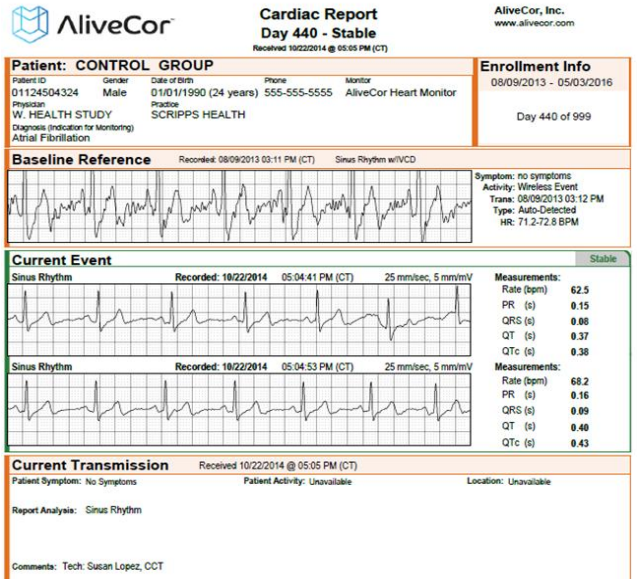
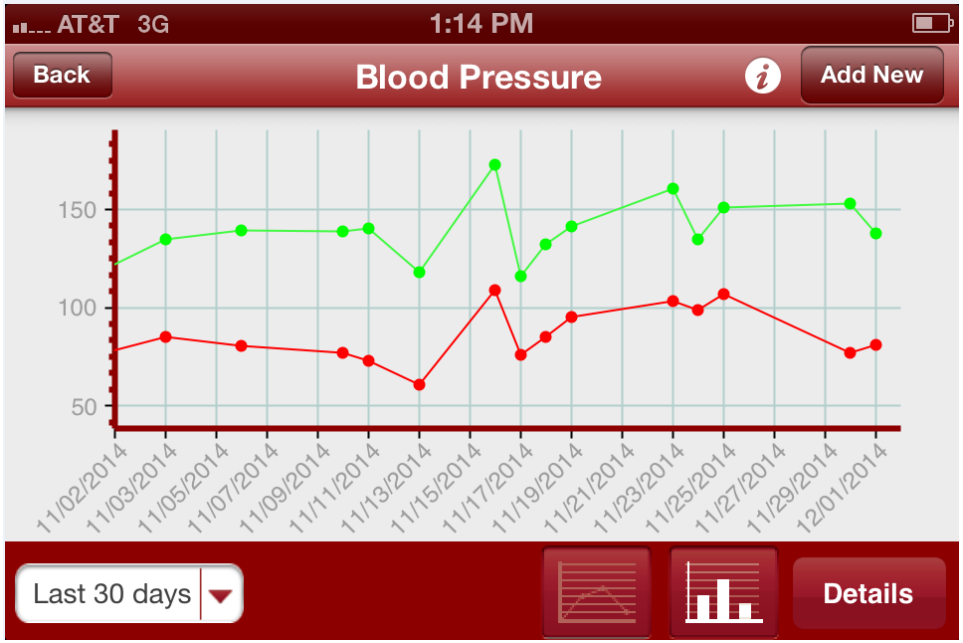
Dec '14


AliveCor
Cardiac Report
Day 440 - Stable
Received 10/22/2014 @ 05:05 PM (CT)
AliveCor, Inc.
www.alivecor.com
Patient: CONTROL GROUP
Patient ID
01124504324
Gender
Male
Date of Birth
01/01/1990 (24 years)
Phone
555-555-5555
Monitor
AliveCor Heart Monitor
Physician
W. HEALTH STUDY
Practice
SCRIPPS HEALTH
Diagnosis (Indication for Monitoring)
Atrial Fibrillation
Enrollment Info
08/09/2013 - 05/03/2016
Day 440 of 999
Baseline Reference
Recorded: 08/09/2013 03:11 PM (CT)
Sinus Rhythm w/IVCD
Symptom: no symptoms
Activity: Wireless Event
Trans: 08/09/2013 03:12 PM
Type: Auto-Detected
HR: 71.2-72.8 BPM
Current Event
Stable
Sinus Rhythm
Recorded: 10/22/2014
05:04:41 PM (CT)
25 mm/sec, 5 mm/mV
Measurements:
Rate (bpm) 62.5
PR (s) 0.15
QRS (s) 0.08
QT (s) 0.37
QTc (s) 0.38
Sinus Rhythm
Recorded: 10/22/2014
05:04:53 PM (CT)
25 mm/sec, 5 mm/mV
Measurements:
Rate (bpm) 68.2
PR (s) 0.16
QRS (s) 0.09
QT (s) 0.40
QTc (s) 0.43
Current Transmission
Received 10/22/2014 @ 05:05 PM (CT)
Patient Symptom: No Symptoms
Patient Activity: Unavailable
Location: Unavailable
Report Analysis: Sinus Rhythm
Comments: Tech: Susan Lopez, CCT


AT&T 3G
1:14 PM
Dashboard
Log Out
HealthComp
Third Party Administrators
Clipboard
Trackers
Medications
Settings

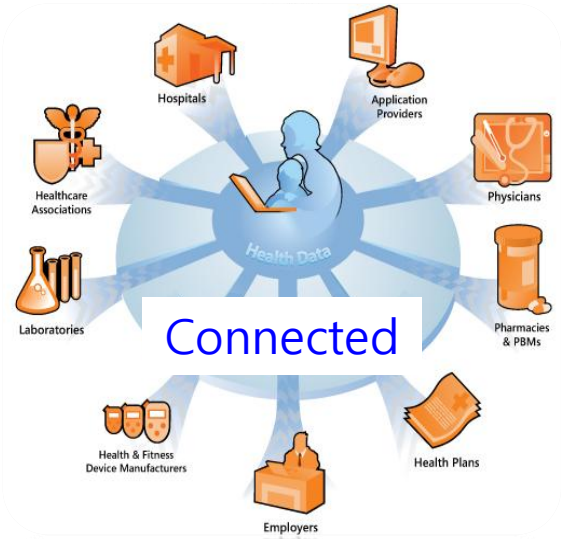

AT&T 3G
1:14 PM
Back
Blood Pressure
Add New
150
100
50
11/02/2014
11/03/2014
11/05/2014
11/07/2014
11/09/2014
11/11/2014
11/13/2014
11/15/2014
11/17/2014
11/19/2014
11/21/2014
11/23/2014
11/25/2014
11/27/2014
11/29/2014
12/01/2014
Last 30 days
Details

Results & Conclusions.

There was little evidence of differences in health care costs or utilization as a result of the intervention. Furthermore, we found evidence that the control and intervention groups were equivalent with respect to most health care utilization outcomes.

PeerJ 4:e1554; DOI 10.7717/peerj.1554, 2016

Big Data + Connected Health



Connected

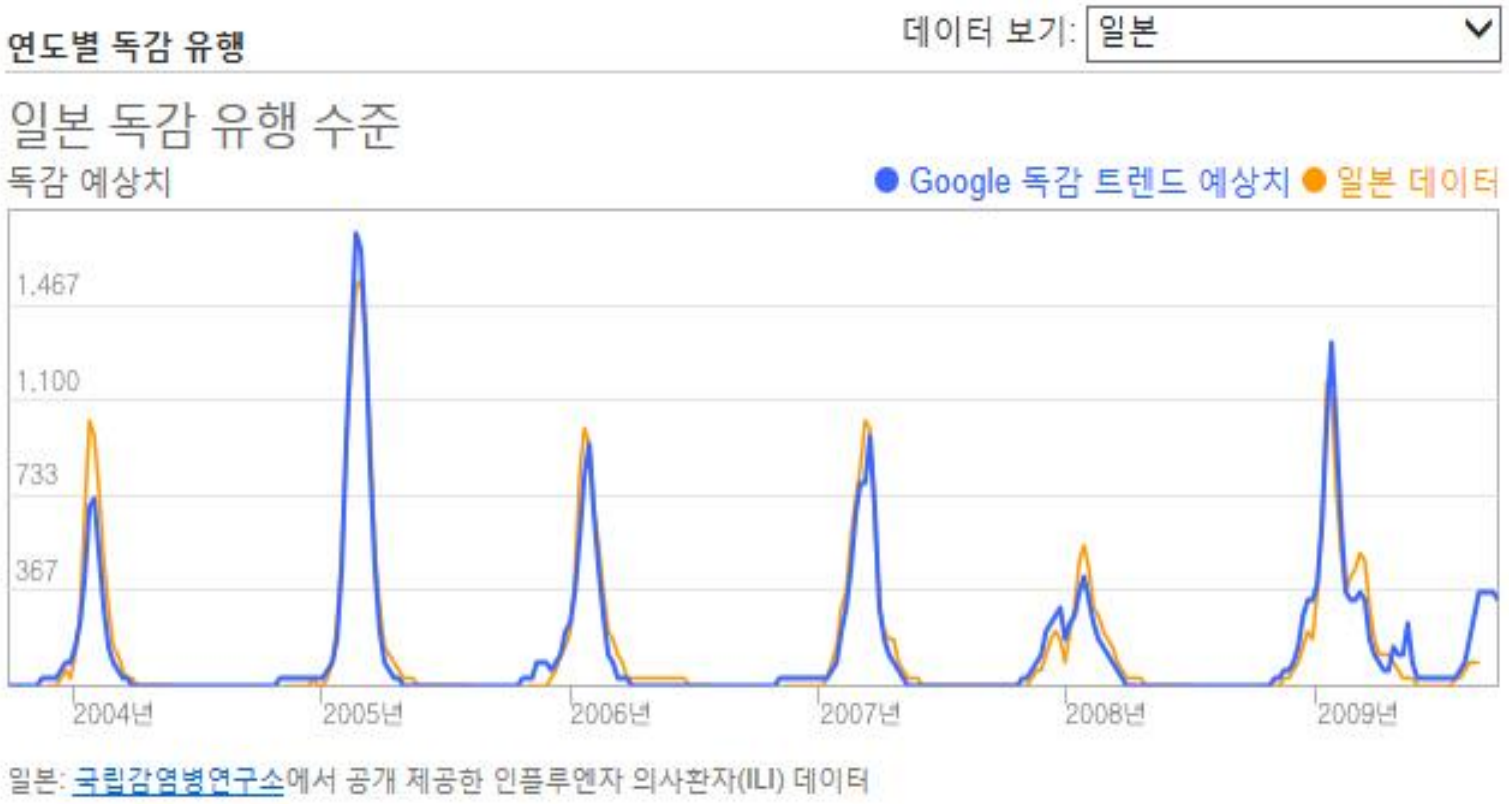
Data

Solution

- Insight
- Intervention

Google 독감 트렌드 (1)

Google 독감 트렌드 (2)



Google 독감 트렌드 (3)

Google Detecting influenza epidemics using search engine query data

nature International weekly journal of science

Access

To read this story in full you will need to login or make a payment (see right).

Letter

Nature **457**, 1012-1014 (19 February 2009) | doi:10.1038/nature07634; Received 14 August 2008; Accepted 13 November 2008; Published online 19 November 2008; Corrected 19 February 2009

Detecting influenza epidemics using search engine query data

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sa=L&ai=CR8TBKdRTU6mxEuXOmgXcvoHwBIy...

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한국경제 2011년 1

구글 '독감예보'는 수많은 클릭의 조합

넘치는 정보 엮어
미래 예측 '빅데이터'

...라클...
...리 등에 활용

글로벌 스토리지업체 EMC관계자가 지난여름 미국 라스베이거스에서 개최한 EMC World 써밋에서 빅데이터 분석 기술을 소개하고 있다.

...을 예보한다. 그것도 미국 보...빠르게.
...릴 수 있지만 사실이다. 구...환자가 늘면 '감기'와 관련...색하는 빈도가 함께 증가한...발견했다. 이를 미국 질병통...이터와 비교해본 결과 검색...독감 증세를 보인 환자 숫자...상관관계가 있다는 사실을...글은 이 같은 분석을 바탕으...를 통해 시간 및 지역별 독감...미국 보건당국보다 한발 앞...었다.
...처럼 정부 당국보다 앞서 정...수 있는 이유는 수많은 사용...에 온갖 종류의 흔적을 남...다. 인터넷에 접속해 이뤄지...은 일종의 상호작용이다. 가...이트에 로그인을 하거나 게...경우 해당 웹사이트 서버에...는다. 실로 막대한 양의 정...는 것이다. 기업들 사이에서...보를 분석해 유의미한 정보...려는 시도가 이어지고 있다....는 물론 미래를 예측하려는 움직임도 있다. 이른바 '빅 데이터'의 시대다.

◆'빅데이터'의시대

소셜네트워크서비스(SNS) 이용자가 급증하고 스마트폰, 태블릿PC 등 모바일 기기가 보편화하면서 사람들이 인터넷에 접속하는 시간의 총량도 크게 늘어났다. 이들이 남기는 데이터 역시 '폭증'한 상황이다. 글로벌 정보기술(IT) 기업인 EMC가 지난 6월 발표한 자료에 따르면 올 한 해 생성 및 복제되는 디지털 정보의 양은 1.8제타바이트에 이를 것이라고 한다. 32기가바이트 용량의 아이패드 575억개가 필요한 숫자다. 이 아이패드를 늘어 놓으면 서울 전체를 두 번 덮고도 남는다. 이 같은 정보량은 2년마다 2배씩 늘어나 2020년에는 관리해야 할 정보량이 지금보다 50여배 늘어날 것이란 예측까지 나오고 있다.

막대한 정보의 홍수 속에서 의미있는 정보를 찾아 미래를 예측하려는 분석은 이미 시도되고 있다. IBM, 오라클, EMC, SAS 등의 업체들이 이런 흐름을 이끌어 나가고 있다. '빅 데이터'로 통칭되는 이 작업은 모바일 센서, 소셜 미디어, CCTV, 의학 영상 자료, 스마트그리드 등 데이터가 폭발적으로 늘어날 수 있는 분야에서 일부 활용되고 있기도 하다.

미국의 한 모바일 통신업체는 이 같은 빅데이터 분석을 통해 고객이 이탈하는 이유와 경로를 밝혀내기도 했다. 이 통신업체는 자사의 고객이 타사로 옮겨가거나 계약을 해지하는 주된 원인을 밝혀내기 위해 일정 기간 계약 해지자의 데이터를 추출해 분석했다. 그 결과 인적 네트워크가 넓고 통화량이 많은 사람이 계약을 해지하면 그와 네트워크를 맺은 고객 가운데 추가 이탈 고객이 많이 나타난다는 사실을 밝혀냈다. 이 통신업체는 인적 네트워크가 넓고 통화량이 많은 고객을 중점적으로 관리하는 정책을 도입해 잠재적 고객 이탈률을 크게 낮출 수 있었다.

미국 온라인 쇼핑몰 이베이에서는 6000여명의 직원이 고객 데이터를 분석·가공하는 일을 하고 있다. 맥킨지의 최근 보고서는 "미국 내에서만 14만~19만명의 정보 분석 전문인력이 필요할 것"이라고 내다보기도 했다. IT 전문지 인포월드는 올해 미국에서 가장 각광받는 신종 IT 직업 6가지 가운데 하나로 데이터 과학자를 꼽기도 했다. 활동 범위가 크게 늘어날 ...에서다. 김경진 한국EMC 대표...정보와 지식을 쌓기만 하는 저...넘어 활용 가치에 집중하는 분...나아가야 한다"고 강조했다.

◆새로운'빅브러더'등장?

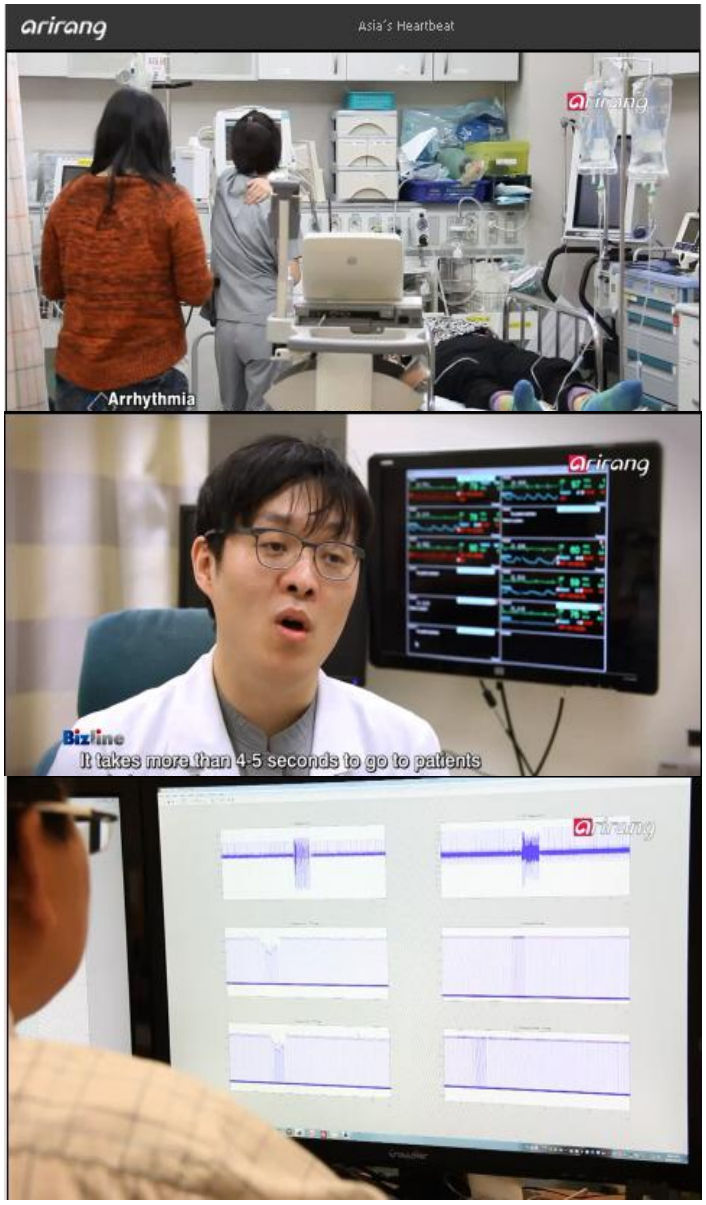
하지만 데이터 분석이 세분화...수록 프라이버시 침해에 대한...늘어나는 것도 사실이다. 빅 ...로운 '빅 브러더'의 등장을 예...란 우려도 있다. 특히 올해 들...싸이월드, 넥슨 메이플스토리...발 등이 잇따라 해킹당하며 ...정보가 유출되기도 했다. 앞서...감 예보처럼 빅 데이터를 통해...익 증진 등 공공선에 기여할 수...사실이다. 하지만 구글을 비롯...기업들은 개인들의 데이터를 ...광고, 특화 서비스 등을 제공하...진에 힘을 쏟는 것도 사실이다...려대 정보보호대학원장은 "...통해 더 편리한 정보를 접할 수...뒤편에서 누가 어떻게 정보를 ...에 대해서도 관심을 가져야 한다.

이승우기자leeswoo@...

where *P* is the percentage of ILI physician visits, *Q* is the ILI-related query fraction, β_0 is the intercept,

...ILI-related query fraction. Maximal performance at estimating out-of-sample points during cross-validation was obtained by summing the top 45 search queries. A steep drop in model performance occurs after adding query 81, which is "oscar nominations".

심정지 전조 현상 : 10초 앞당긴다.



- ✓ 중환자실 환자 모니터 장비의 데이터 분석으로 미세한 심장의 변화를 찾아내 갑작스러운 돌연사를 일으키는 부정맥을 미리 감지한다면

- ✓ 심실 부정맥 예측 서비스를 담당한 신수용 서울아산병원 교수는"심전도, 심박수 등을 활용하여 심실부정맥 징후를 예측해 위급상황을 사전에 대처하고

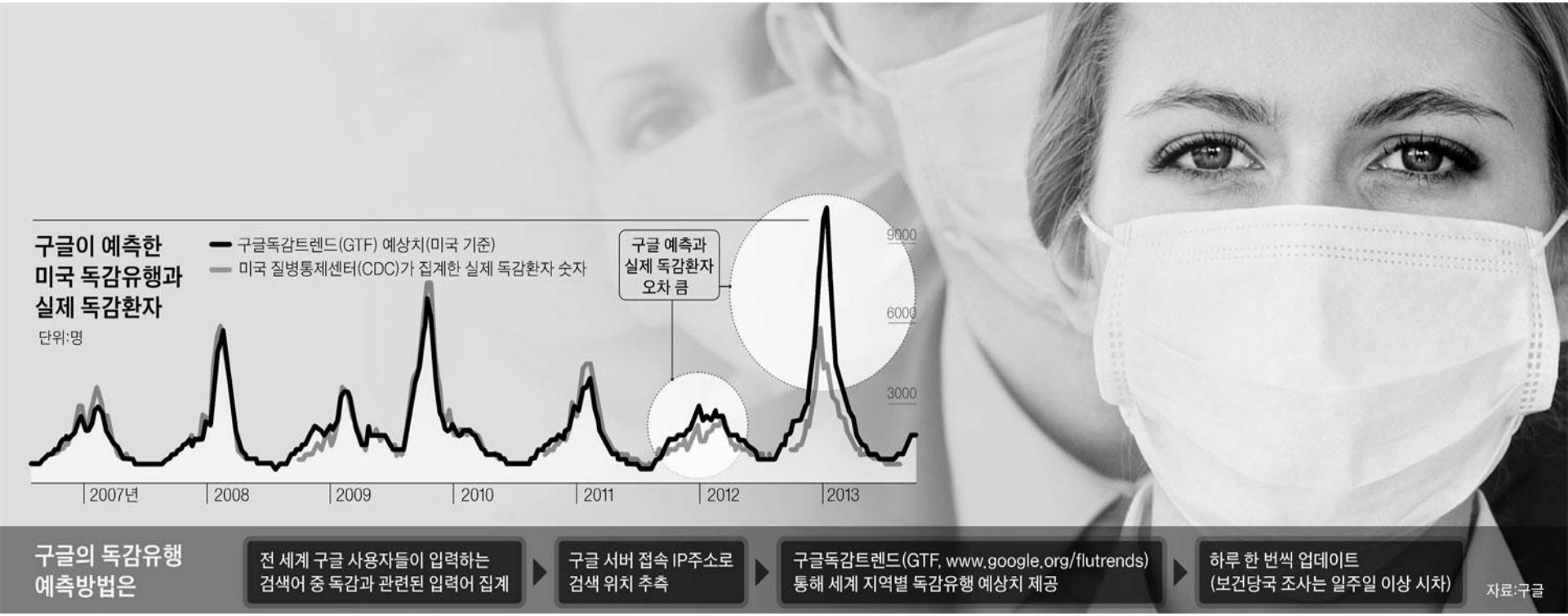
- ✓ 2013. 9. 5 Arirang TV 방송
http://www.arirang.co.kr/Tv2/TVCommon_NoStaff_Archive.asp?Prog_Code=TVCR0685&MENU_CODE=101709&view_seq=6648&sys_lang=Kor (29분 30초 ~ 34분 15초 사이)

Google 독감 트렌드 (4)

빅데이터의 배신?

[중앙일보] 입력 2014.03.14 03:00 / 수정 2014.03.14 03:00

정확도 소문났던 구글 독감 예측 최근 2년간 틀려 …
전문가 "빅데이터 분석법 진화 중"



American Heart Association, IBM Watson Health and Welltok Team Up to Transform Heart Health

AHA to Infuse Cognitive Computing, Personalization and Science-Based Standards into New Workplace Health Offering

February 01, 2016 | Categories: Program News

NEW YORK CITY (February 1, 2016) – Today, the first day of American Heart Month, the American Heart Association (AHA) announced plans to develop a first of its kind workplace health solution that leverages the cognitive computing power of IBM Watson. In the first application of Watson to cardiovascular disease, AHA, IBM, and Welltok will create a new offering that combines AHA's science-based metrics and health assessments with cognitive analytics, delivered on Welltok's health optimization platform. The effort is intended to help alleviate the burden of cardiovascular diseases, which affect more than 85 million Americans today.

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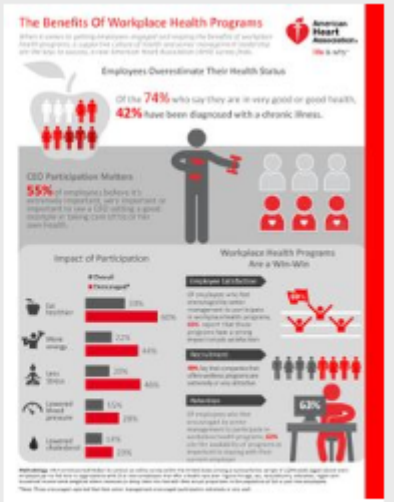

CEORT Employee Health Infographic


심혈관 질환 예방 및 관리방안 마련을 위한 업무협약(MOU) 체결
2016. 2. 23.

Challenges to translation

- Lack of solid clinical evidence
- Financial obstacles
- Security and Privacy
- Overloaded data

Summary

- Beyond mere convenience, Smart Health has potential to improve healthcare
- Its ecosystem is still in its early formative stages.
- Potential to decrease the cost of both clinical research and health care.

경청해주셔서 감사합니다.