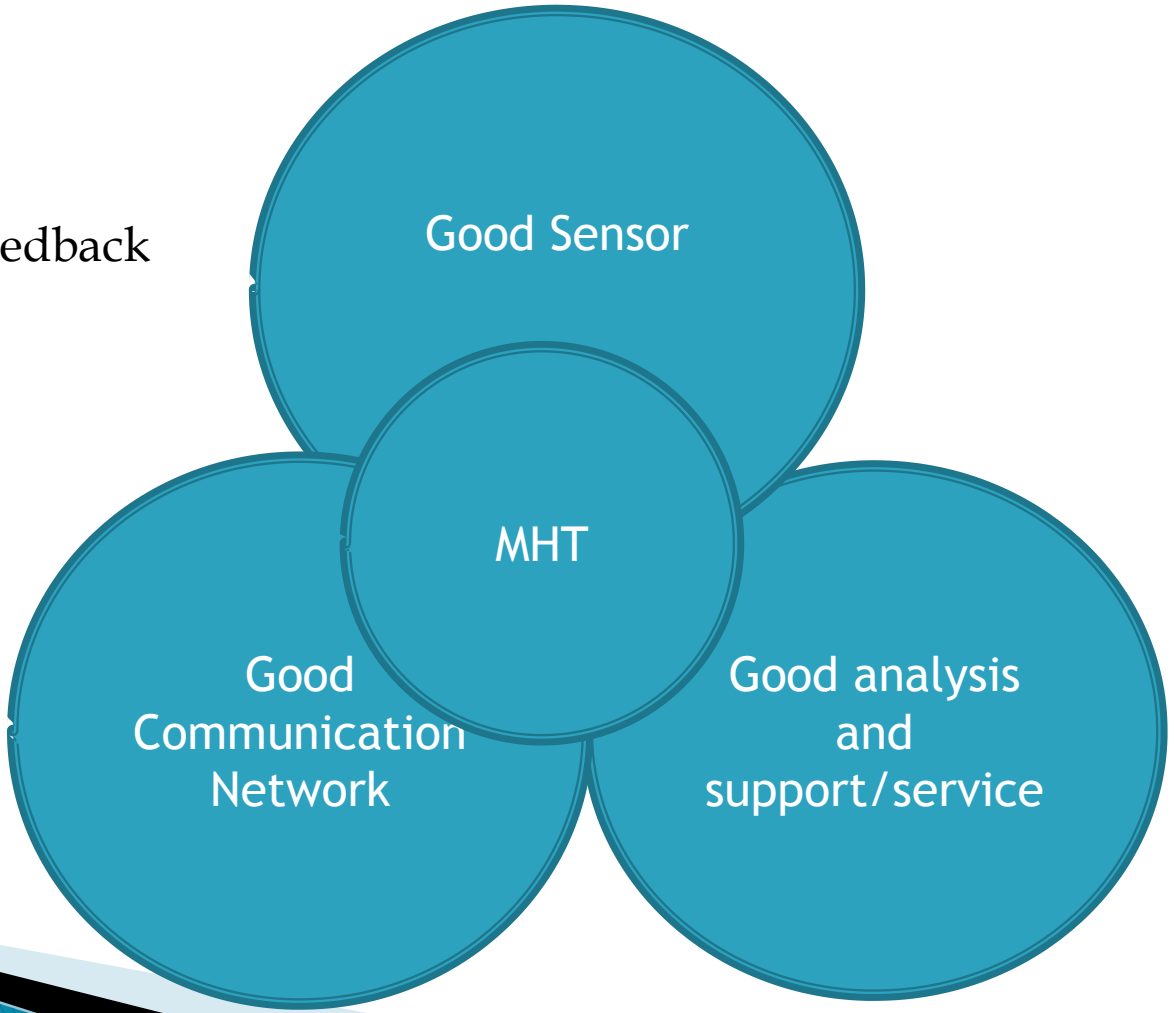
Mobile Healthcare Technology

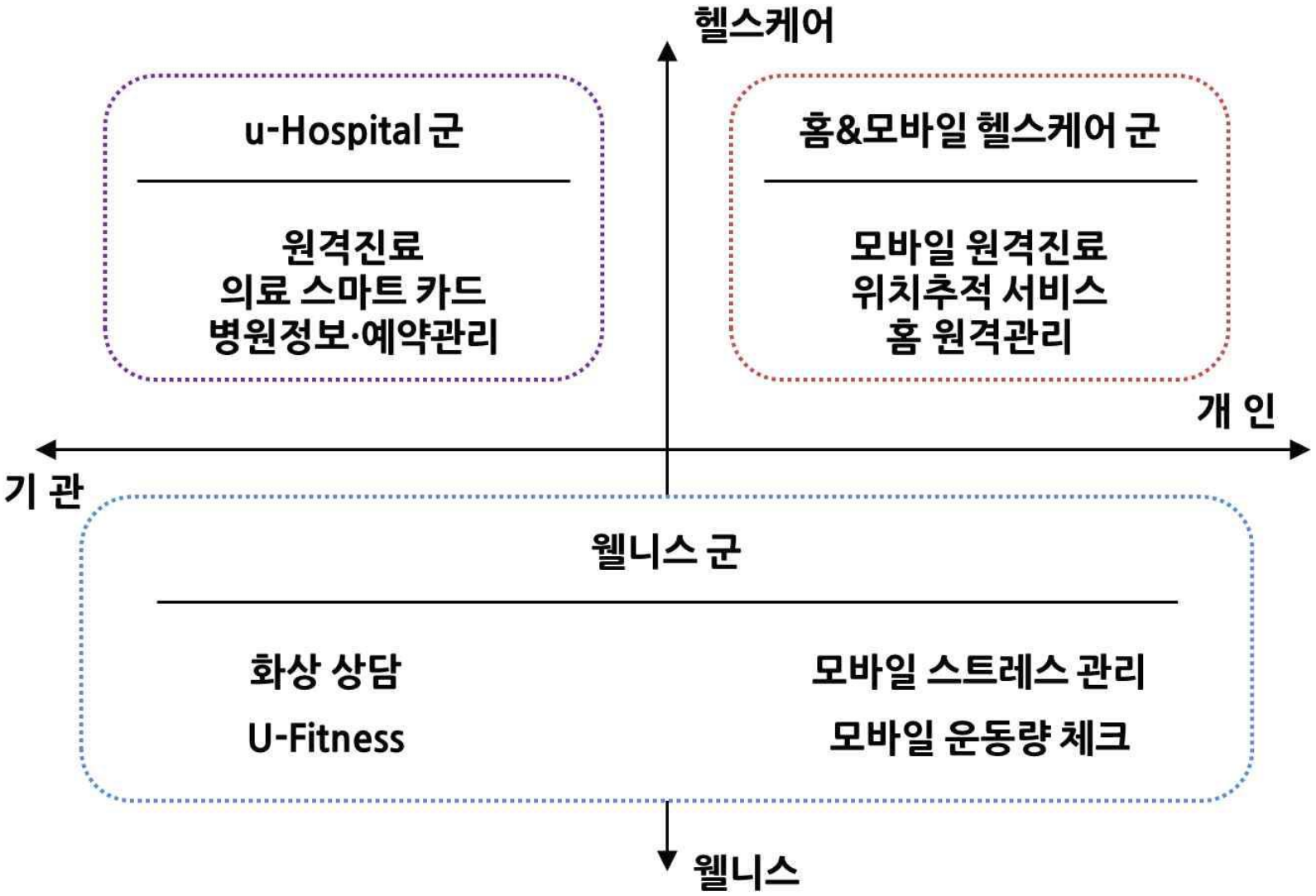
계명대학교 의과대학 김윤년

Mobile Healthcare Technology(MHT)

- Wireless
- Realtime
- Minimize
- Network
- Analysis and feedback



홈 & 모바일 헬스케어


헬스케어
u-Hospital 군
원격진료
의료 스마트 카드
병원정보·예약관리
홈&모바일 헬스케어 군
모바일 원격진료
위치추적 서비스
홈 원격관리
개 인
기 관
웰니스 군
화상 상담
U-Fitness
모바일 스트레스 관리
모바일 운동량 체크
웰니스

MHT

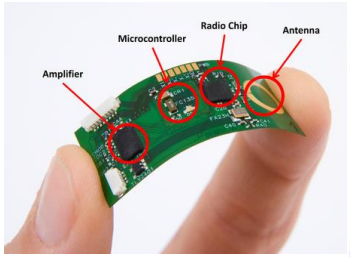
- The health care system faces daunting challenges.
  - With the improvements in health care in the last few decades, residents of industrialized countries are now **living longer**, but with **multiple, often complex**, health conditions
  - Survival from acute trauma has also improved, but this is associated with an increase in the number of individuals with **severe disabilities**

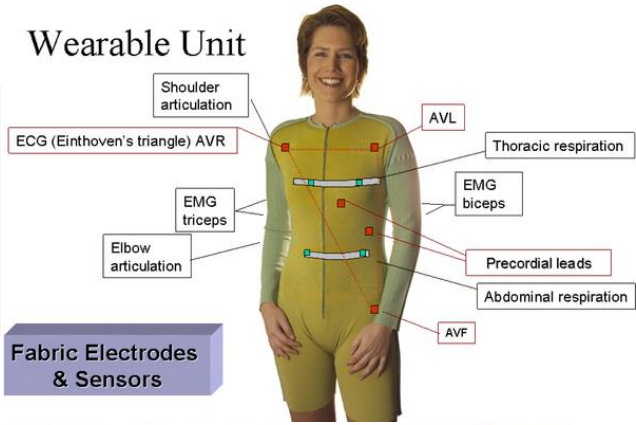
Fundamental questions

- How do we care for an increasing number of individuals with complex medical conditions?
- How do we provide quality care to those in areas with reduced access to providers?

Key enabling technologies for Health monitoring systems

- Wearable systems for patients' remote monitoring

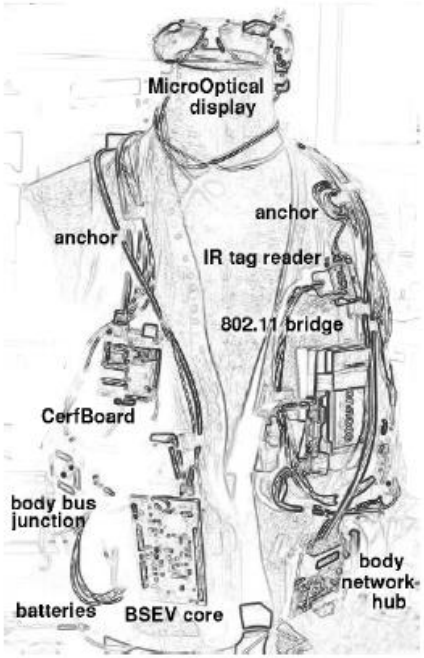




- The miniaturization of sensors and electronic circuits
  - The flexible circuit
  - MEMS technology

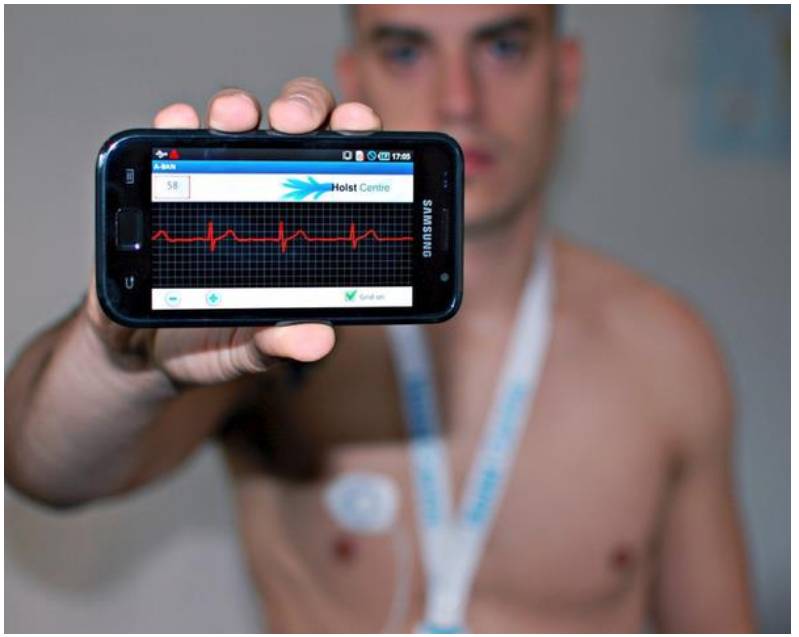
- Advances in material science
  - e-textile

  - Health monitoring applications of wearable systems
    - MIThril system



Key enabling technologies for Health monitoring systems

- Mobile phone technology
  - Smart phones are broadly available.
  - Global smart phone market is growing at an **annual rate of 35%**
  - GPS tracking system
  - Cloud-based system

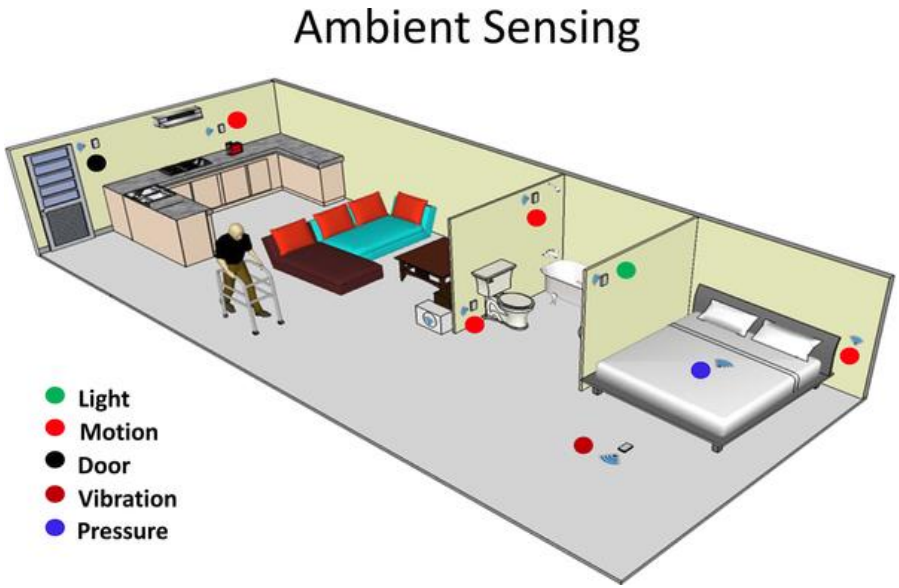


Key enabling technologies for Health monitoring systems

- **Data analysis techniques** such as signal processing, pattern recognition, data mining and other artificial intelligence-based methodologies have enabled remote monitoring applications that would have been otherwise impossible.
- Data analysis- Big data Mining

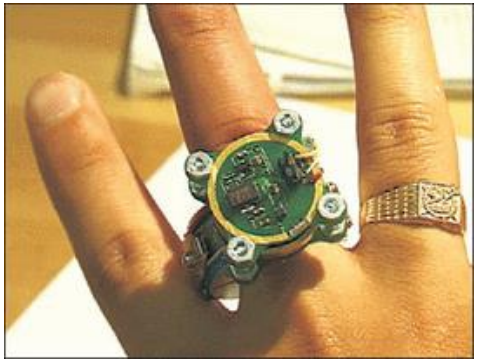
Sensing technology

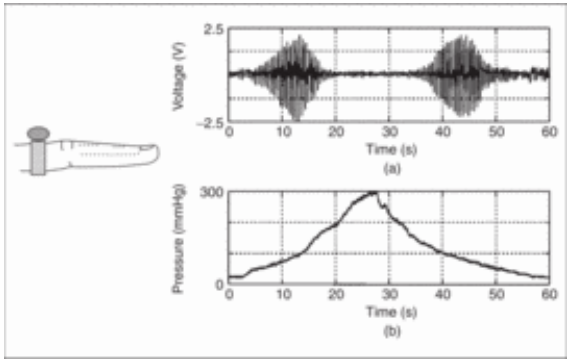
- Information gathered using body-worn (i.e. wearable) sensors
- Wearable sensors are often combined with ambient sensors
  - Specifically-designed data analysis procedures would then be used to **detect falls** via processing of **motion and vital sign data.**



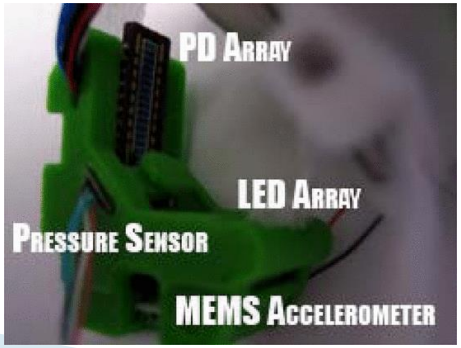
Wearable sensors

- Physiological measures of interest in rehabilitation
  - Integrating physiological monitoring in a wearable system often requires ingenious designs and novel sensor locations.
  - Ring sensor design for measuring blood oxygen saturation (SpO2) and heart rate



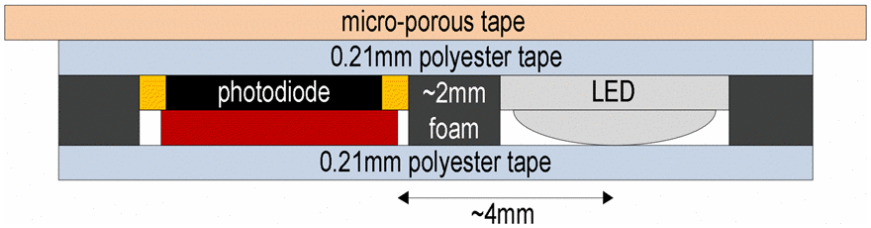


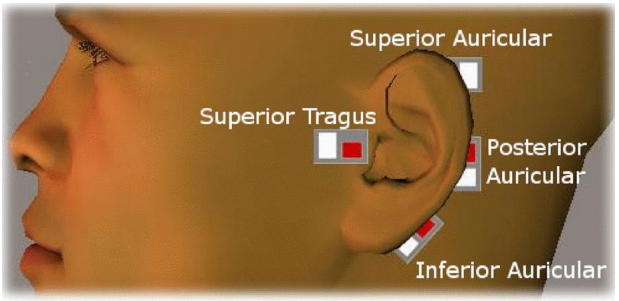
  - Self-contained wearable cuff-less PPG based blood pressure monitor



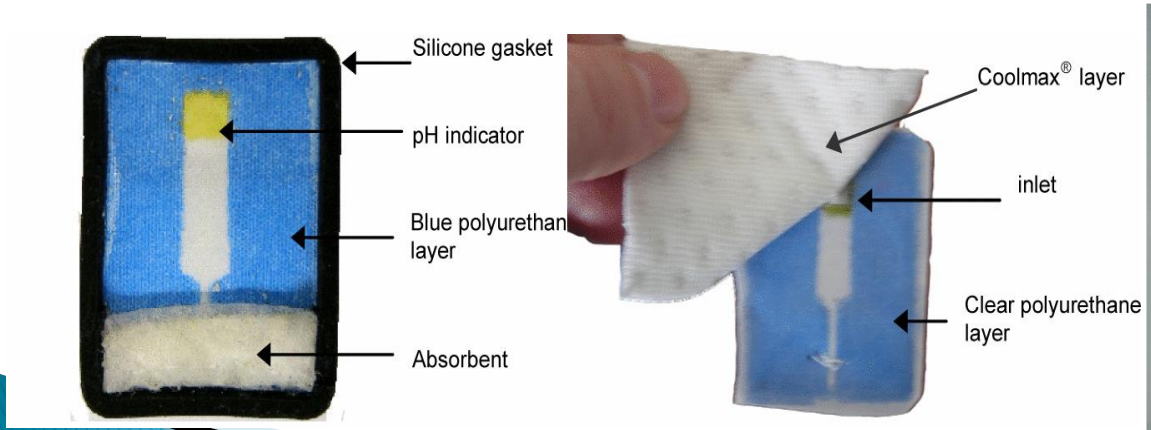
Wearable sensors

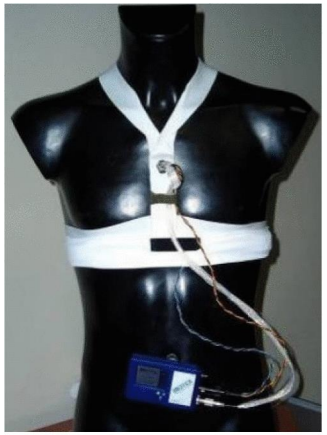
- Physiological measures of interest in rehabilitation
  - Ear-worn, flexible, low-power PPG sensor

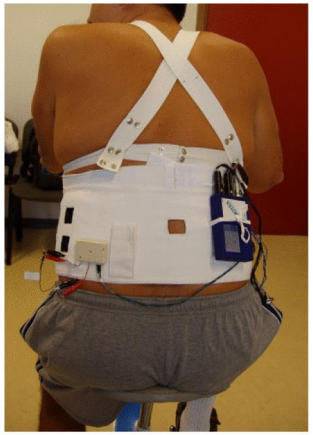




  - BIOTEX project (European Commission)
    - An array of bio-chemical sensors

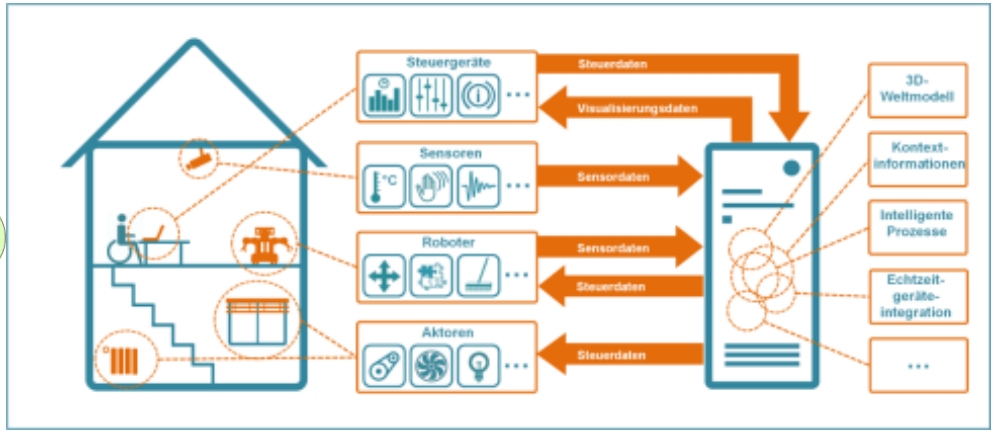






Ambient sensors

- Ambient Assisted Living (AAL)
  - Embedded
  - Personalized
  - Anticipatory



- Smart home projects
  - The Technology Research for Independent Living (TRIL) Center in Ireland
  - The TigerPlace in Missouri
  - The Oregon Center for Aging and Technology (ORCATECH) in Oregon
  - The University of Rochester Center for Future Health
  - The University of Florida Gator-Tech Smart House
  - The Georgia Institute of Technology Aware Home
  - The Massachusettes Institute of Technology PalceLab

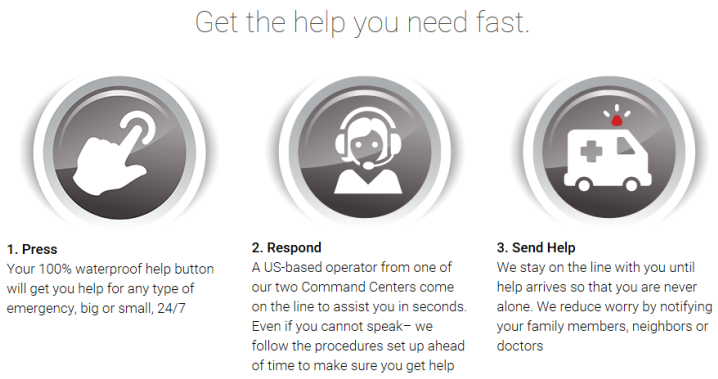
Applications : Health and Wellness monitoring

- Activities of Daily Living (ADL)
  - In-shoe pressure and acceleration sensor system
  - To classify activities including **sitting, standing, and walking** with the ability of detecting whether subjects were simultaneously performing arm reaching movements.

Applications : Safety monitoring

- Safety monitoring applications, such as **detecting falls and relaying alarm messages** to a caregiver or an emergency response team
  - Commercially-available devices designed for safety monitoring
    - The Life Alert Classic by Life Alert Emergency Response Inc.

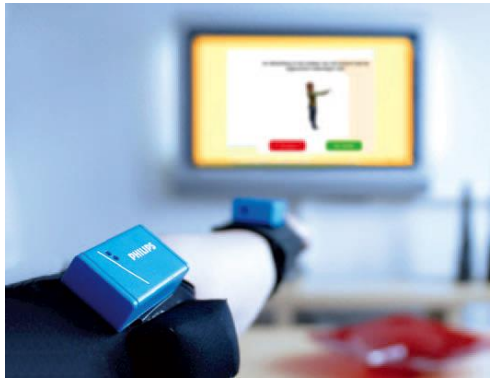
    - The Alert One medical alert system



Applications : Home rehabilitation

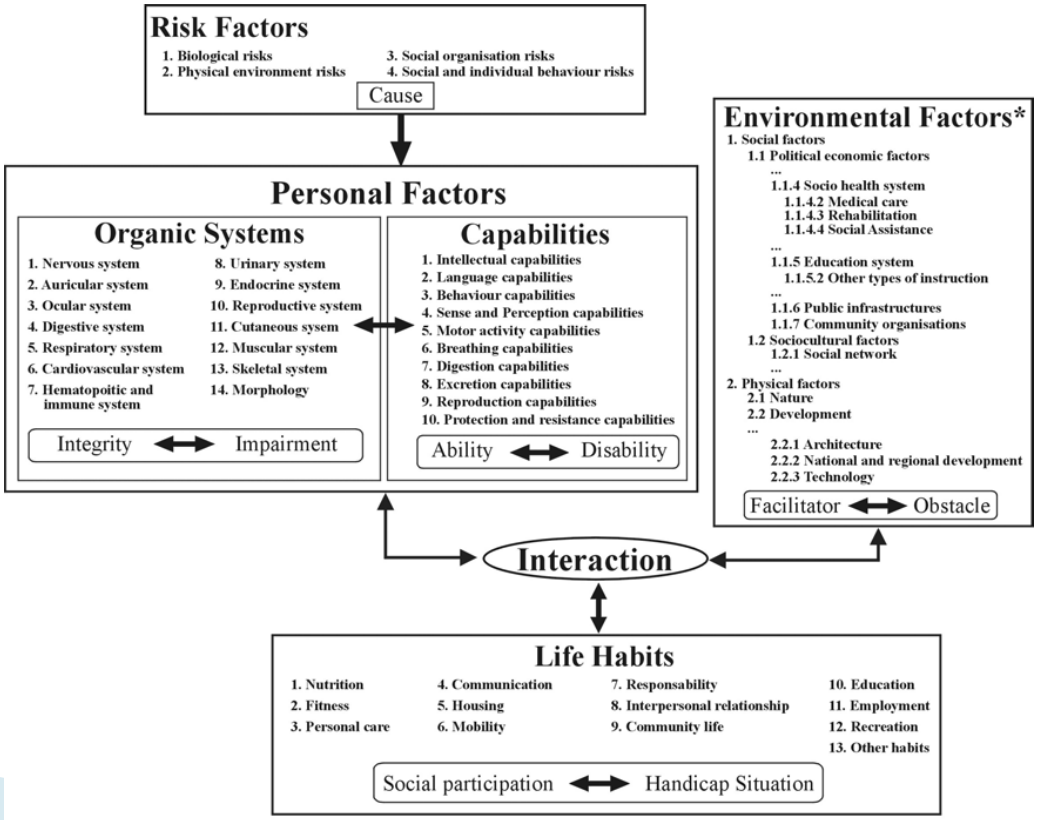
- Virtual Reality (VR) and Gaming for Home-Based Motor Assessment & Training
  - By the Rehabilitation Engineering Research Center at the University of Southern California
  - VR simulation technology has been applied **to improve motor skills** in subjects

- Stroke Rehabilitation Exerciser
  - By Philips Research
  - A wireless inertial sensor system **records the patient's movements, analyzes the data** for deviations from a personal movement target and **provides feedback to the patient and the therapist**



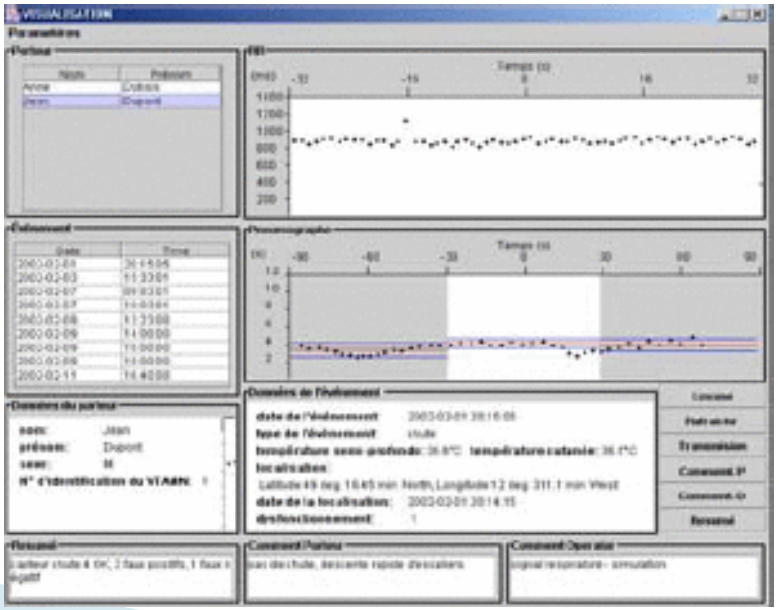
Applications :
Assessment of treatment efficacy

- A quantitative way of assessing treatment efficacy can be a valuable tool for clinicians in disease management.
  - By knowing what happens between outpatient visits, treatment interventions can be fine-tuned to the needs of individual patients
  - The Disability Creation Process, conceptual scheme



Applications :
Early detection of disorders

- An area of growing interest in the field of wearable technology is to achieve **early detection of changes in patient's status** requiring clinical intervention.
  - VTAMN project
    - Smart Cloth for Ambulatory Remote Monitoring of Physiological Parameters and Activity
    - Monitoring of patients with **chronic obstructive pulmonary disease**
    - Simultaneous monitoring of **activities** and several physiological parameters such as **heart rate, respiration and oxygen saturation** using wearable sensors and systems



ACC 2015

The Characteristics of Digital Imaging

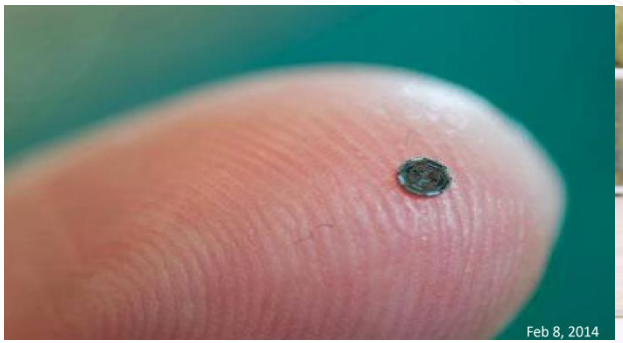
- Miniaturization
- Connectivity
- Wearable
- Convergence
- Holographic Imaging

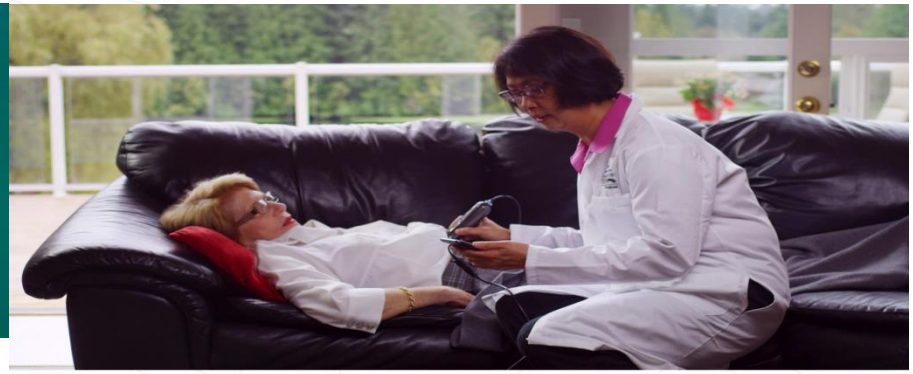
Specific Segments

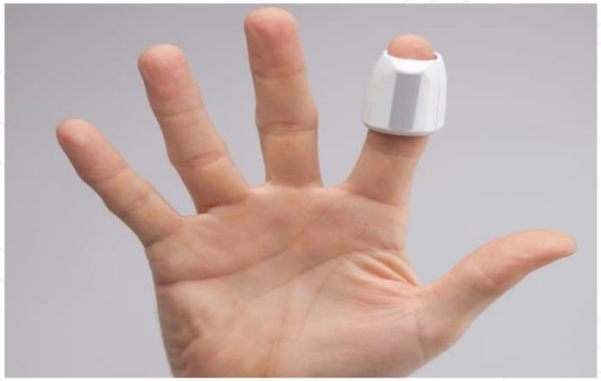
- Teleradiology
- Teledermatology
- Ophthalmology
- ENT
- Global Health
- Remote Medicine

THE FUTURE OF CARDIOVASCULAR MEDICINE at ACC.15


GE Healthcare
Vscan

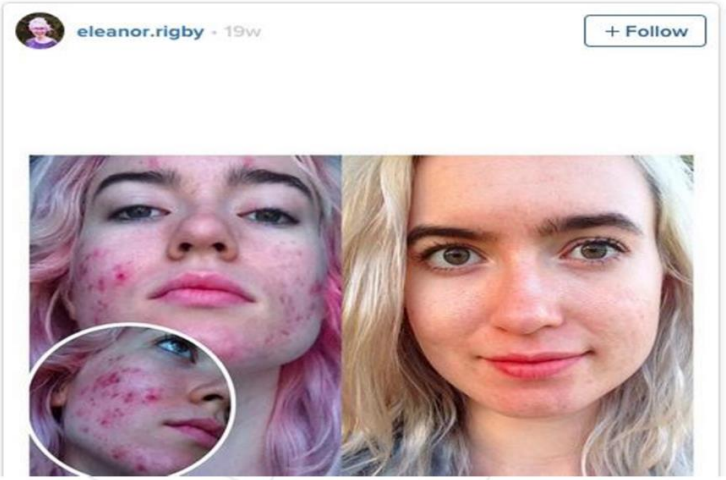

Feb 8, 2014



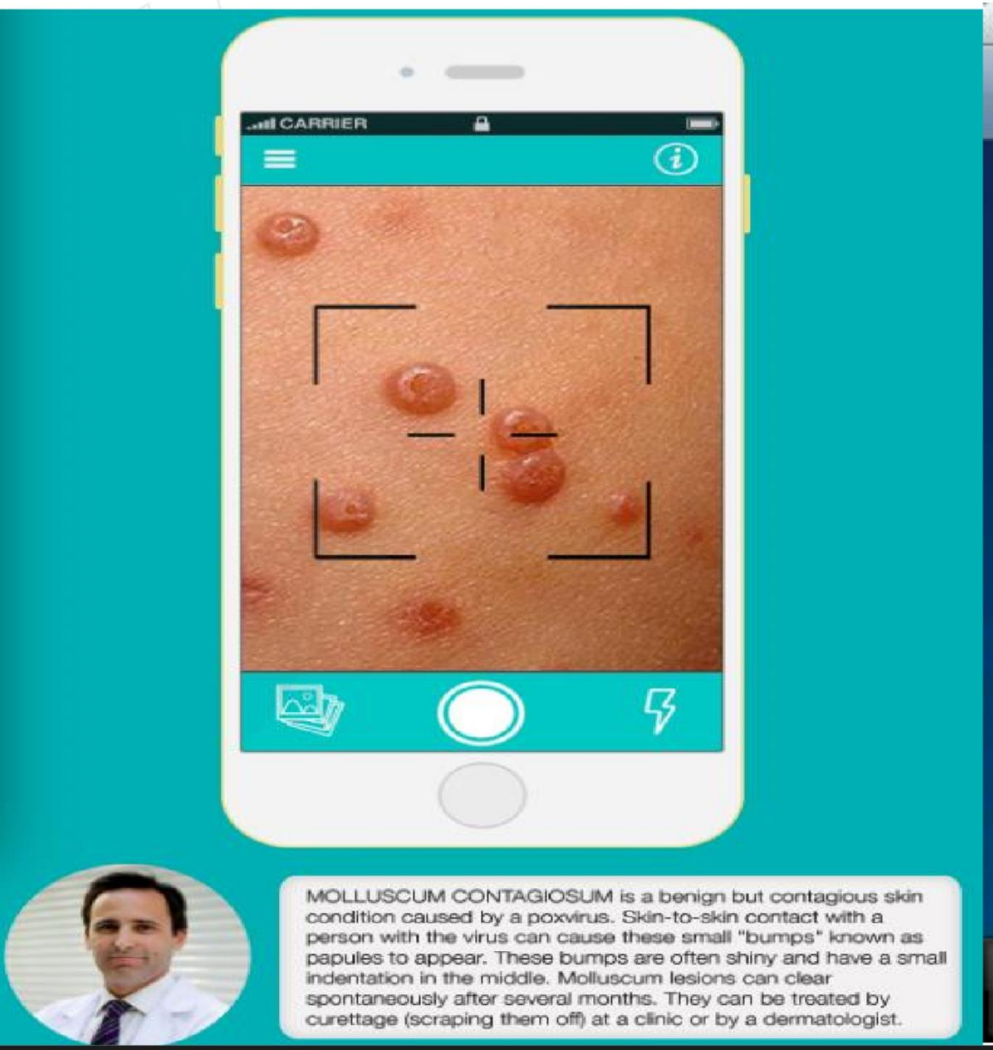


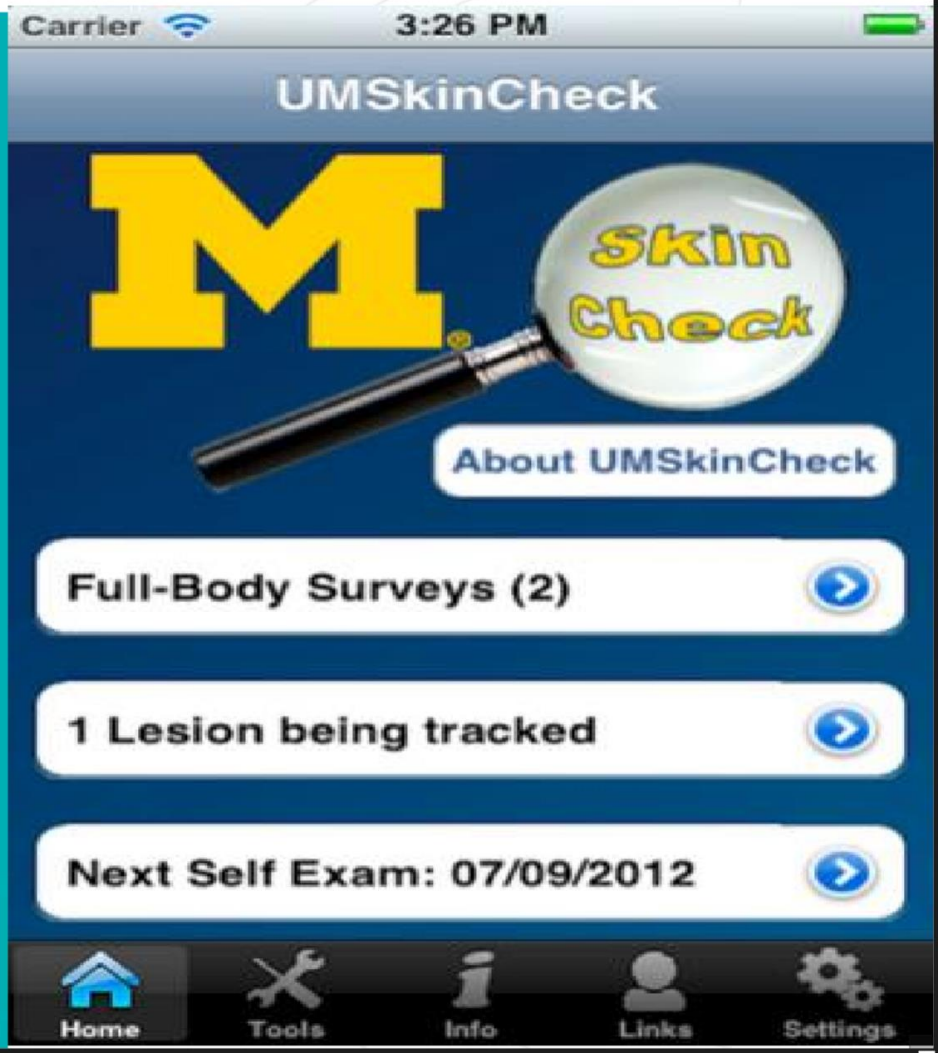

7:11 AM
RECORD
HISTORY
60 bpm
AliveECG
60 bpm

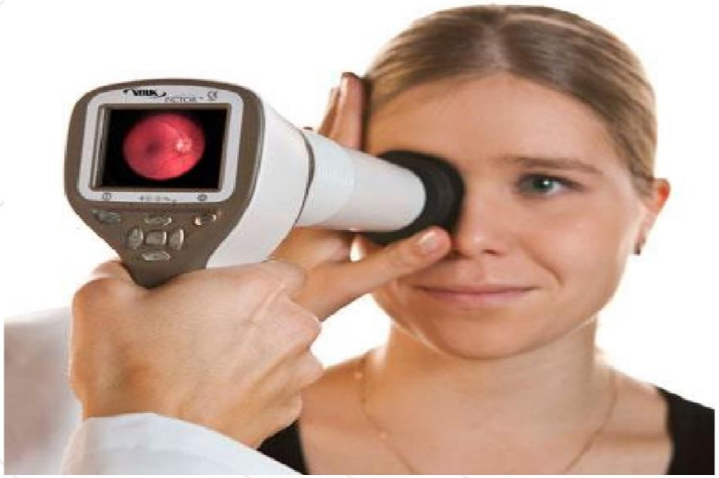
On Instagram



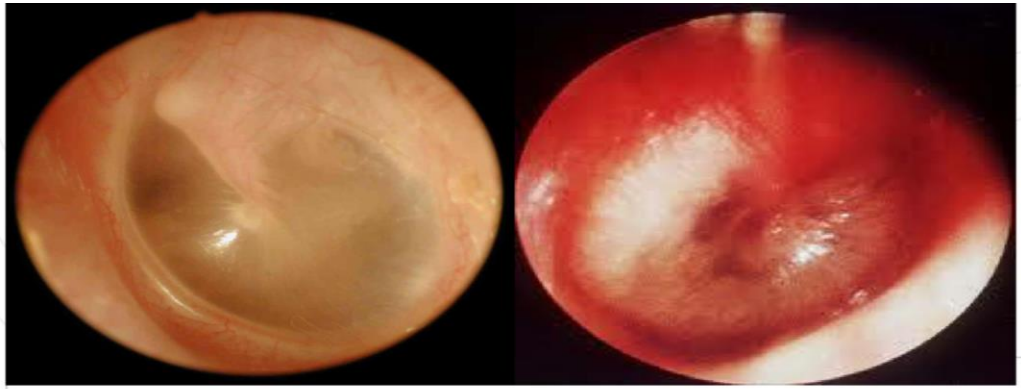
On Twitter

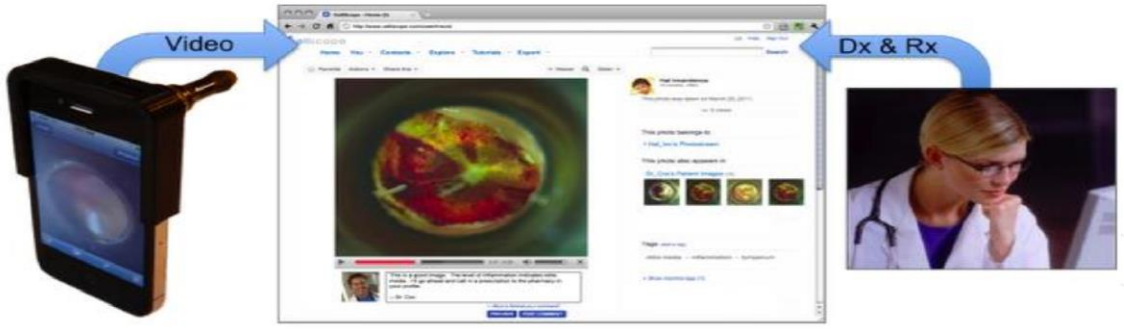

CARRIER
MOLLUSCUM CONTAGIOSUM is a benign but contagious skin condition caused by a poxvirus. Skin-to-skin contact with a person with the virus can cause these small "bumps" known as papules to appear. These bumps are often shiny and have a small indentation in the middle. Molluscum lesions can clear spontaneously after several months. They can be treated by curettage (scraping them off) at a clinic or by a dermatologist.

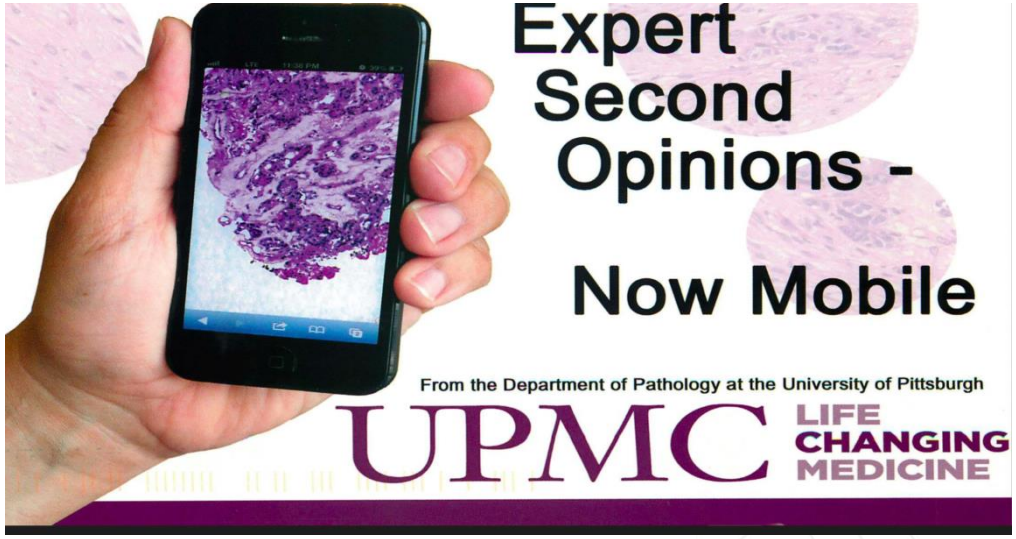

Carrier
3:26 PM
UMSkinCheck
Skin Check
About UMSkinCheck
Full-Body Surveys (2)
1 Lesion being tracked
Next Self Exam: 07/09/2012
Home
Tools
Info
Links
Settings




cellscope

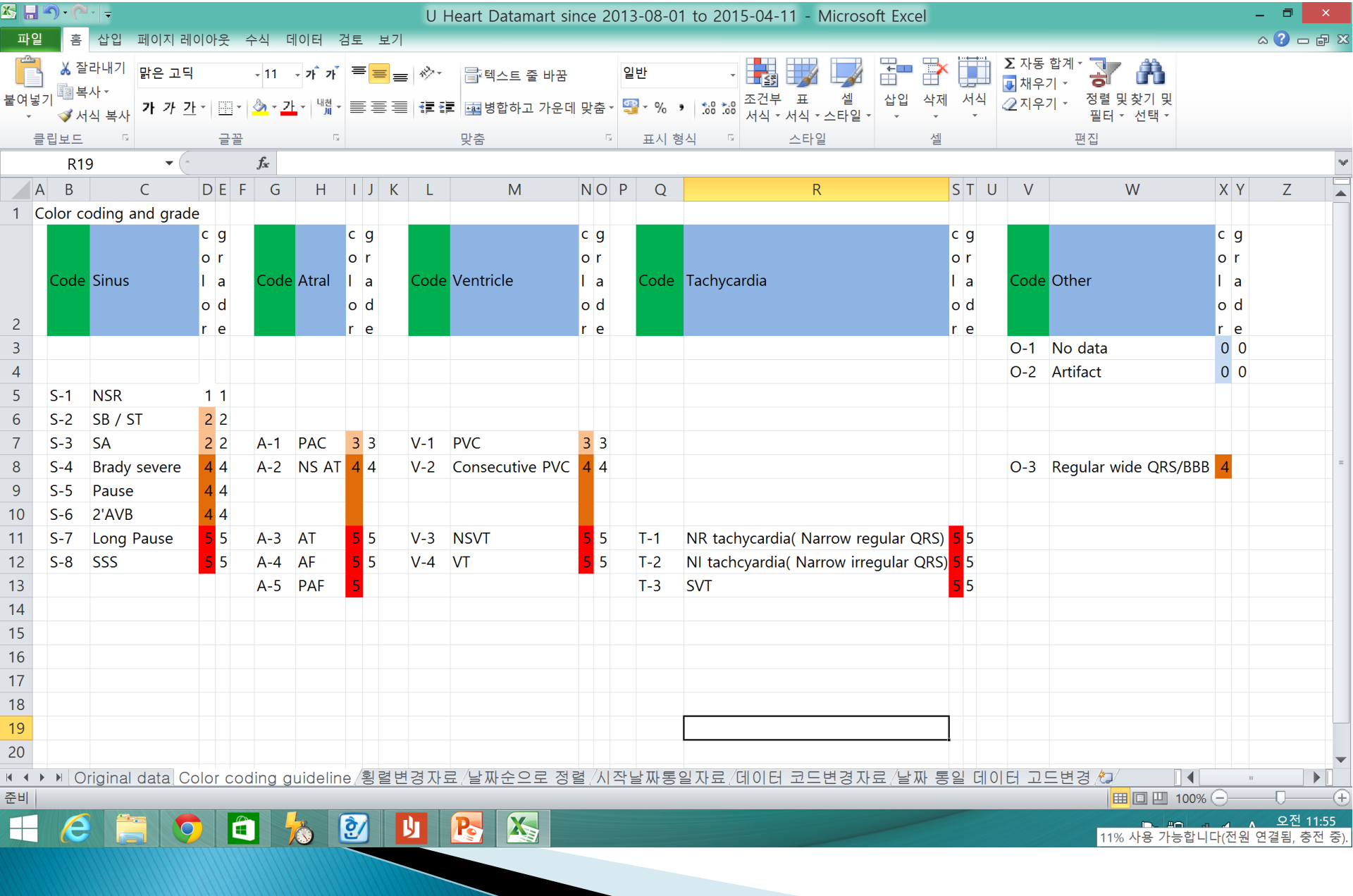



Video
Dx & Rx


Expert
Second
Opinions -
Now Mobile
From the Department of Pathology at the University of Pittsburgh
UPMC
LIFE
CHANGING
MEDICINE

Heartcall

Duration: 2013년 8월1일 - 2015년 4월 12일
Smartphone user
460명



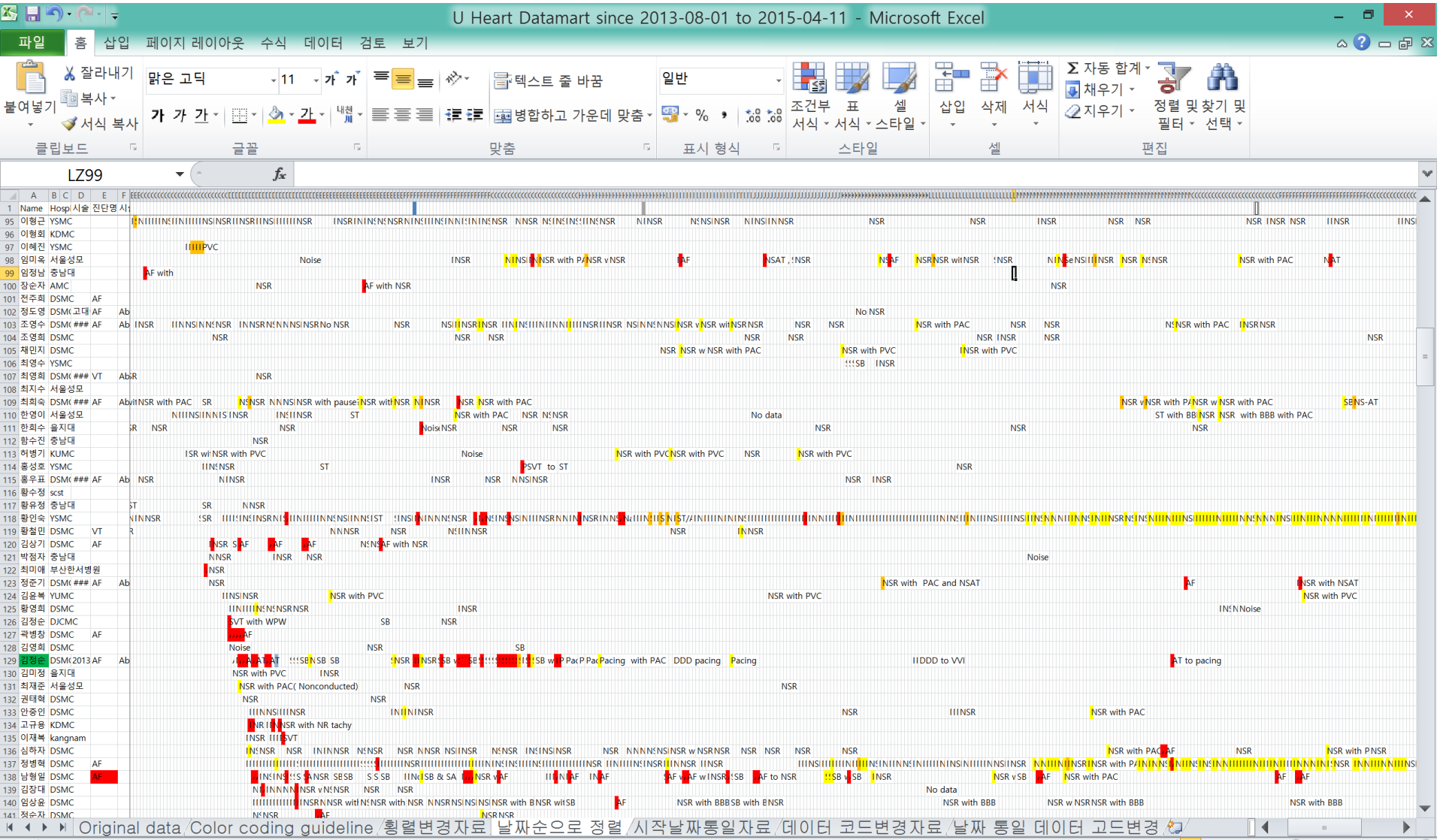
Code	Sinus	color	grade
S-1	NSR	1	1
S-2	SB / ST	2	2
S-3	SA	2	2
S-4	Brady severe	4	4
S-5	Pause	4	4
S-6	2'AVB	4	4
S-7	Long Pause	5	5
S-8	SSS	5	5

Code	Atral	color	grade
A-1	PAC	3	3
A-2	NS AT	4	4
A-3	AT	5	5
A-4	AF	5	5
A-5	PAF	5	

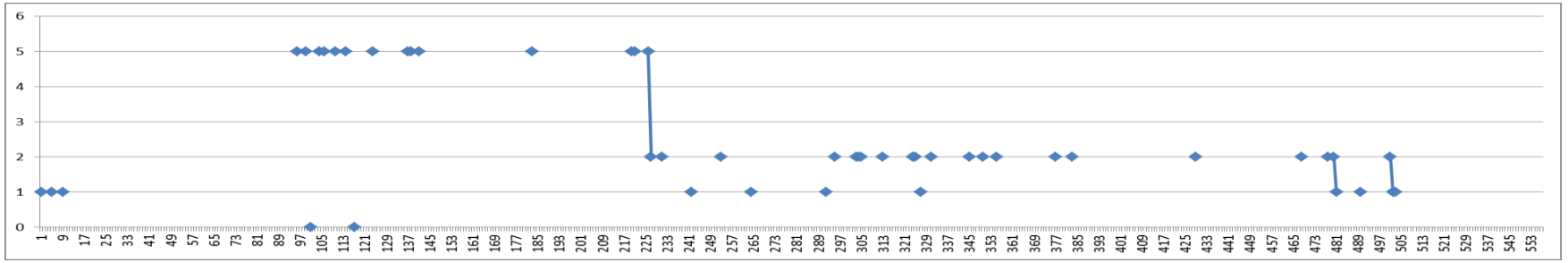
Code	Ventricle	color	grade
V-1	PVC	3	3
V-2	Consecutive PVC	4	4
V-3	NSVT	5	5
V-4	VT	5	5

Code	Tachycardia	color	grade
T-1	NR tachycardia(Narrow regular QRS)	5	5
T-2	NI tachcyardia(Narrow irregular QRS)	5	5
T-3	SVT	5	5

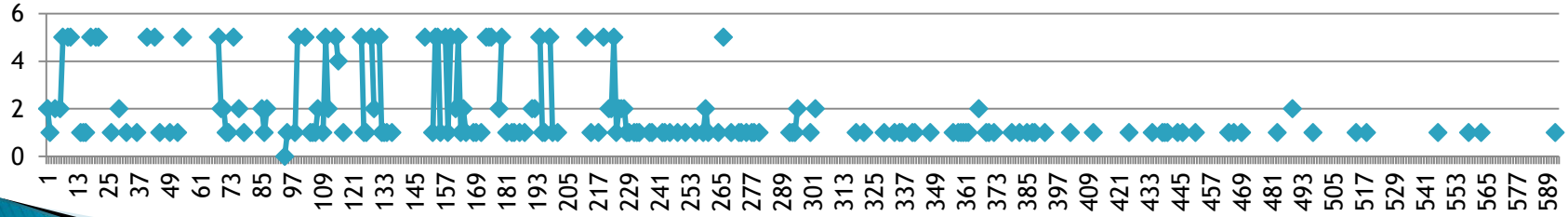
Code	Other	color	grade
O-1	No data	0	0
O-2	Artifact	0	0
O-3	Regular wide QRS/BBB	4	


U Heart Datamart since 2013-08-01 to 2015-04-11 - Microsoft Excel
파일
홈
삽입
페이지 레이아웃
수식
데이터
검토
보기
LZ99
Original data
Color coding guideline
횡렬변경자료
날짜순으로 정렬
시작날짜통일자료
데이터 코드변경자료
날짜 통일 데이터 고드변경
준비
50%
오전 11:56
2015-04-15

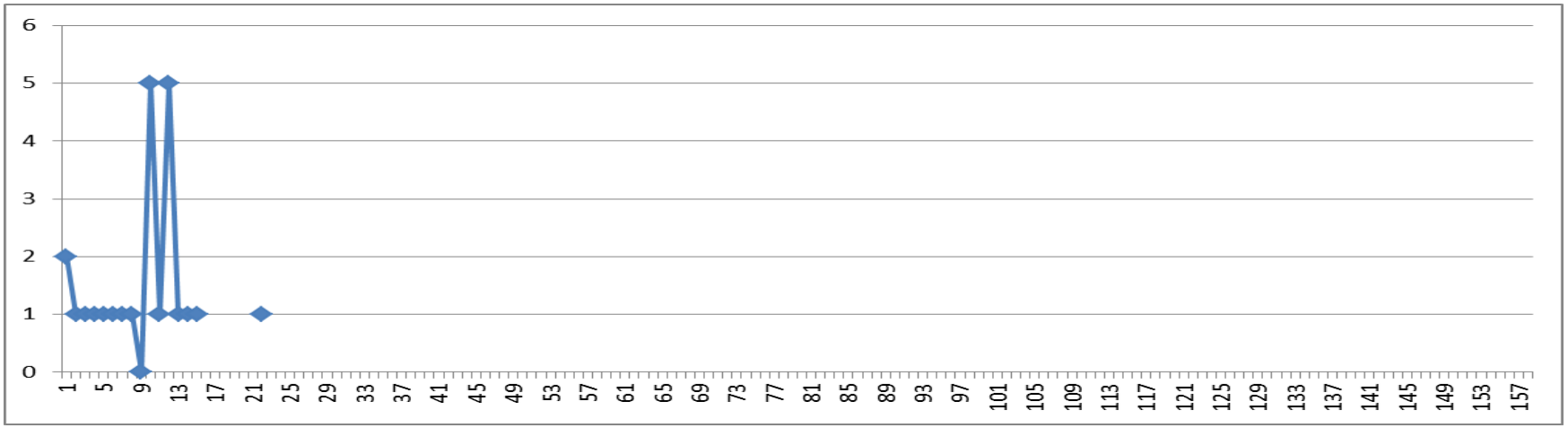
DC cardioversion



AF ablation



Early detection- Recurrent syncope



Sx

14:00, 식사 후 대화 도중 앉은 채로 눈앞이 캄캄해지며 졸도 후 10초 후 의식 되찾음
16:00, 식탁에 앉은 채로 옆으로 졸도하여 10초 후 의식 되찾음
19:00, 주방에서 선채로 뒤로 넘어졌고 10초 후 의식 되찾음

21:00, 도로 산책 중 눈 앞이 캄캄해지며 뒤로 넘어져 10초 후 의식 되찾았고 응급실 내원하여 brain CT 상

1. No abnormal high or low density in brain
2. Soft tissue swelling in left parietooccipital area
3. Suspicious left occipital bone fracture

소견보였고 vasovagal syncope 가능성 높아 RTC f/u 하도록 하며 퇴원함. 이후 LMC 이비인후과 방문하여 w/u 상 이석 문제는 아니라고 들음

아산병원 방문하여 ECG, holter, 핵의학 검사 시행하였으나 unremarkable

총 8차례에 걸쳐 10-15초 가량의 실신 발생함

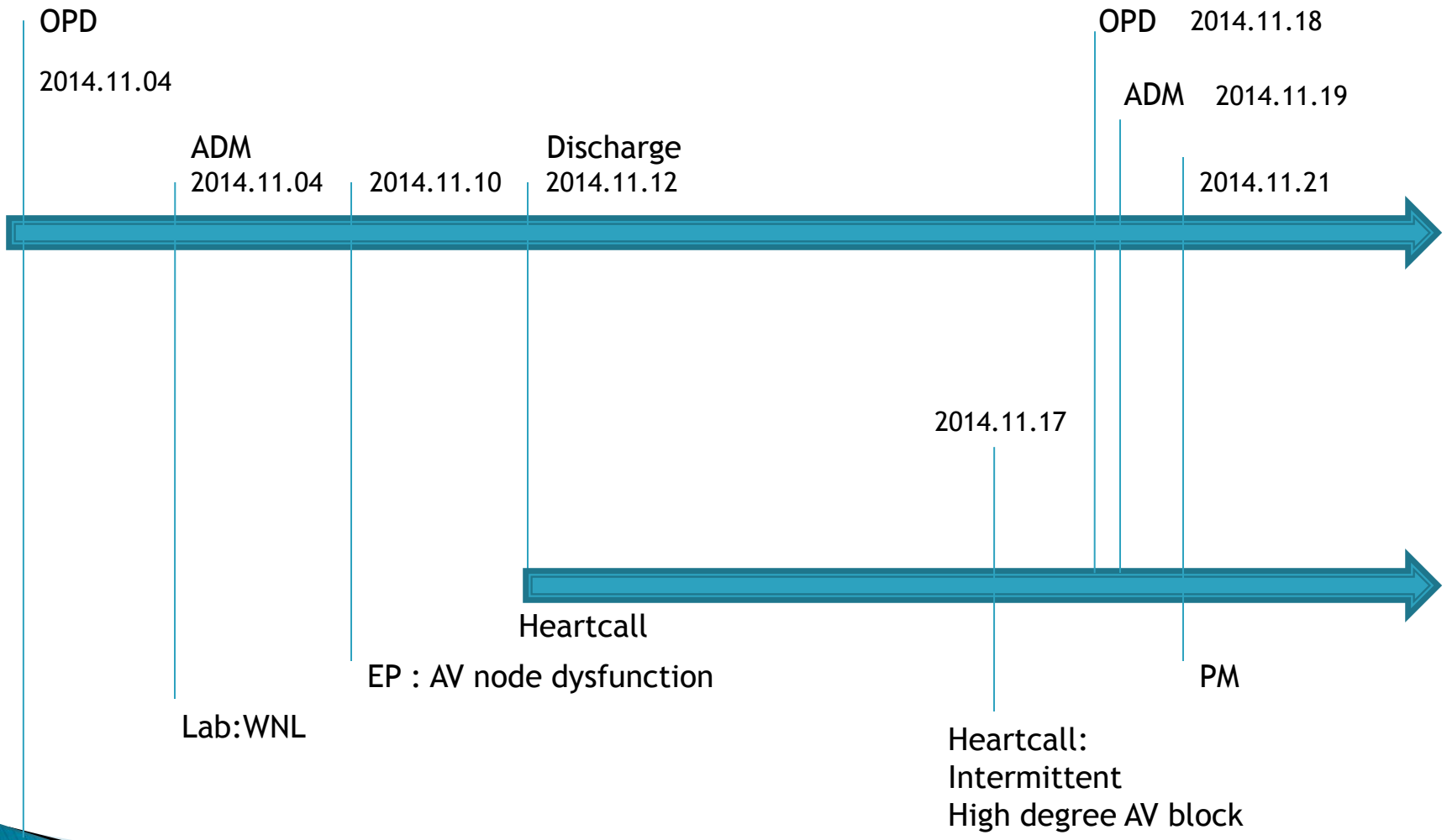
12:00, 산책 후 집으로 돌아 오던 중 실신 발생하여 10여초 후 의식 되찾음
13:45, 동산의료원 내원하여 ECG 시행 대기 하던 중 실신 발생하여 10여초 후 의식 되찾음

12:00 마루에서 눈앞이 캄캄해 지며 15초 후 깨어남
18:00 침대에서 눈앞이 캄캄해 지며 15초 후 깨어남

11:05 마루에서 서있던 중 눈 앞이 캄캄해 지며 15초 후 깨어남
11:10 침대에서 눈앞이 캄캄해 지며 15초 후 깨어남
11:15 침대에서 눈앞이 캄캄해 지며 15초 후 깨어남
17:00 침대에서 눈앞이 캄캄해 지며 15초 후 깨어남
17:31 침대에서 눈앞이 캄캄해 지며 15초 후 깨어남
20:12 동산의료원 응급실에서 실신 발생 하여 15초 후 깨어남
20:16 동산의료원 응급실에서 실신 발생 하여 15초 후 깨어남
20:21 동산의료원 응급실에서 실신 발생 하여 15초 후 깨어남

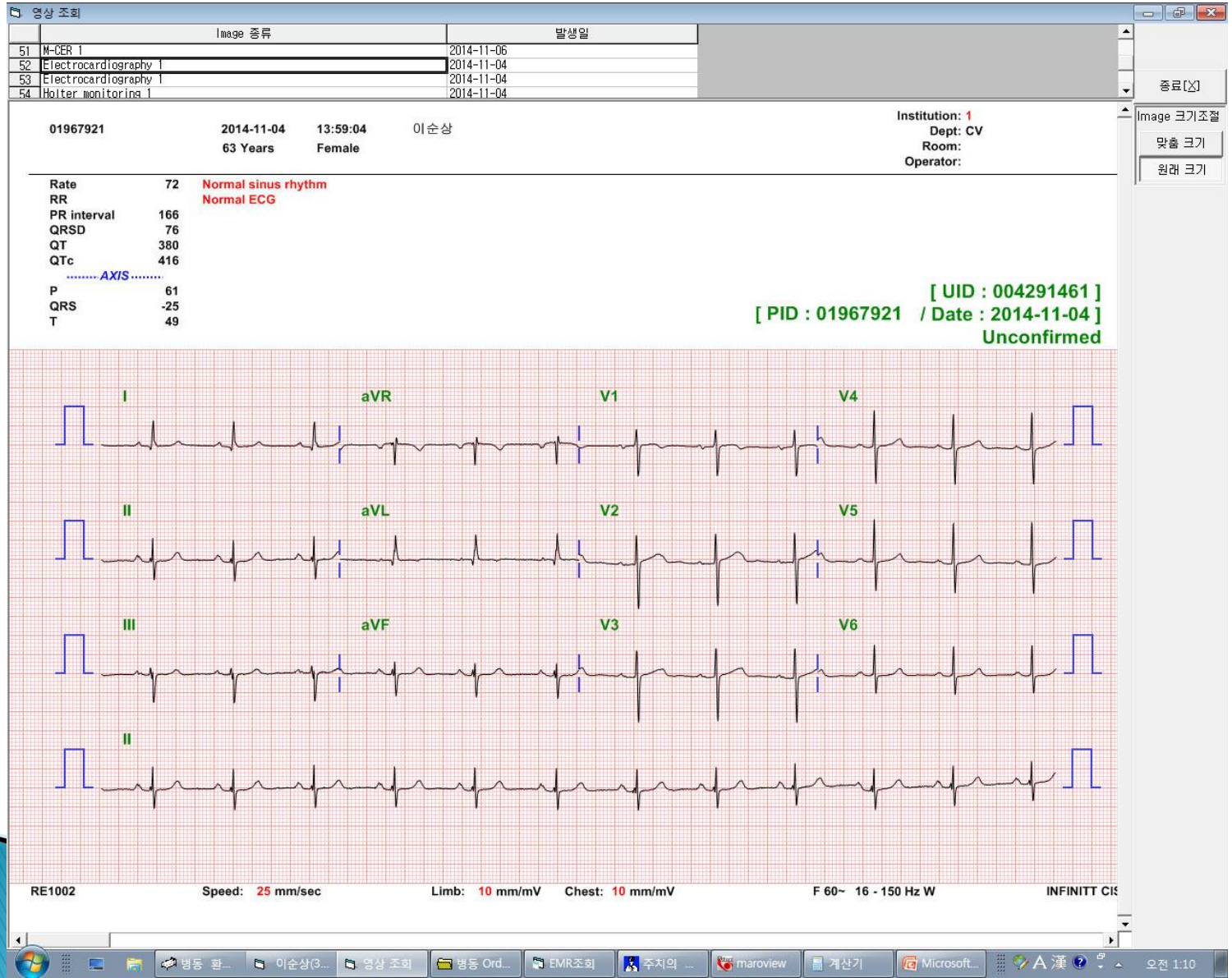
14.8.26
14.9.08
14.9.23
14.10.31
14.11.4
14.11.15
14.11.17

Lab

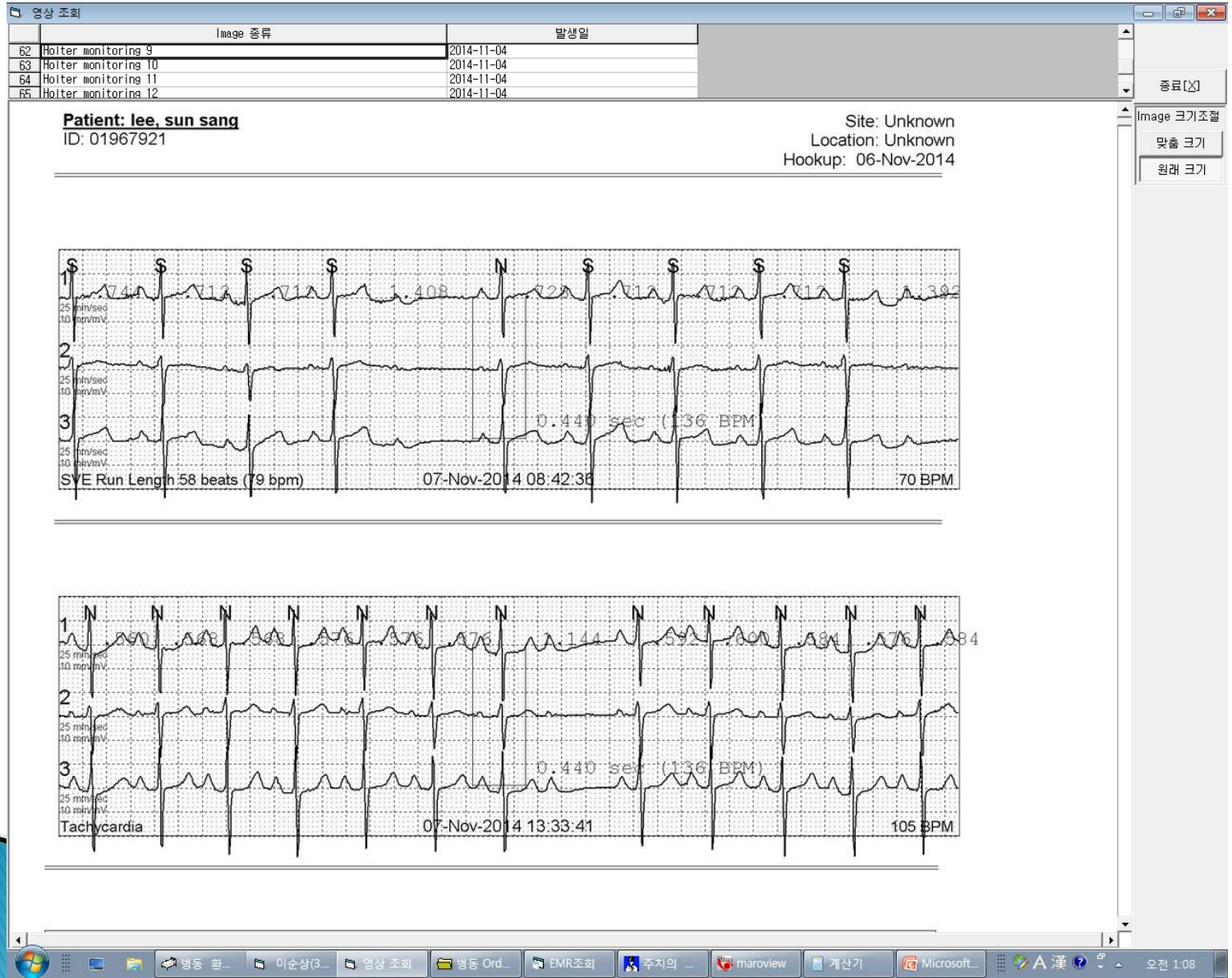

OPD
2014.11.04
ADM
2014.11.04
2014.11.10
Discharge
2014.11.12
OPD 2014.11.18
ADM 2014.11.19
2014.11.21
2014.11.17
Heartcall
EP : AV node dysfunction
PM
Lab:WNL
Heartcall:
Intermittent
High degree AV block
Lab:WNL

Brain CT(14.09.08)

ECG(14.11.04)


영상 조회
Image 종류
발생일
51 M-CER 1 2014-11-06
52 Electrocardiography 1 2014-11-04
53 Electrocardiography 1 2014-11-04
54 Holter monitoring 1 2014-11-04
종료[X]
Image 크기조절
맞춤 크기
원래 크기
01967921
2014-11-04
63 Years
13:59:04
Female
이순상
Institution: 1
Dept: CV
Room:
Operator:
Rate 72
RR
PR interval 166
QRSD 76
QT 380
QTc 416
AXIS
P 61
QRS -25
T 49
Normal sinus rhythm
Normal ECG
[UID : 004291461]
[PID : 01967921 / Date : 2014-11-04]
Unconfirmed
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
RE1002
Speed: 25 mm/sec
Limb: 10 mm/mV
Chest: 10 mm/mV
F 60~ 16 - 150 Hz W
INFINITT CIS
오전 1:10

Holter(14.11.06)



TMT(14.11.10)

영상 조회

	Image 종류	발생일
41	Tread-mill test 29	2014-11-10
42	Tread-mill test 30	2014-11-10
43	Tread-mill test 31	2014-11-10
44	IPD-AGREEMENT 1	2014-11-09

종료[X]

Image 크기조절

맞춤 크기

원래 크기

Yi, Soon sang
Patient ID 01967921
2014/11/11 Female 150 cm 52.5 kg
10:52:53am 63yrs 153/65 mmHg

12SL Report

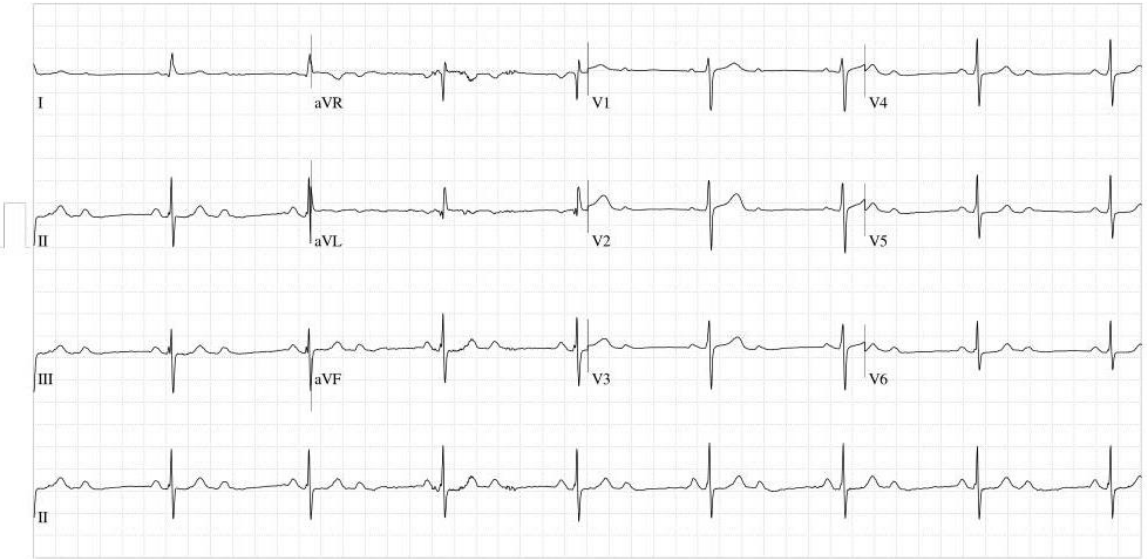
DONGSAN HOSPITAL [MR-040-090-20101231]

PRETEST MODBRUCE
STANDING 0.0 km/h
0:52 0.0 %

Vent. Rate	50 bpm
PR interval	154 ms
QRS duration	90 ms
QT/QTc	386/351 ms
P-R-T axes	80/ 9/70
P duration	108 ms
RR interval	1210 ms

Sinus rhythm with 2nd degree AV block with 2:1 AV conduction
Abnormal ECG

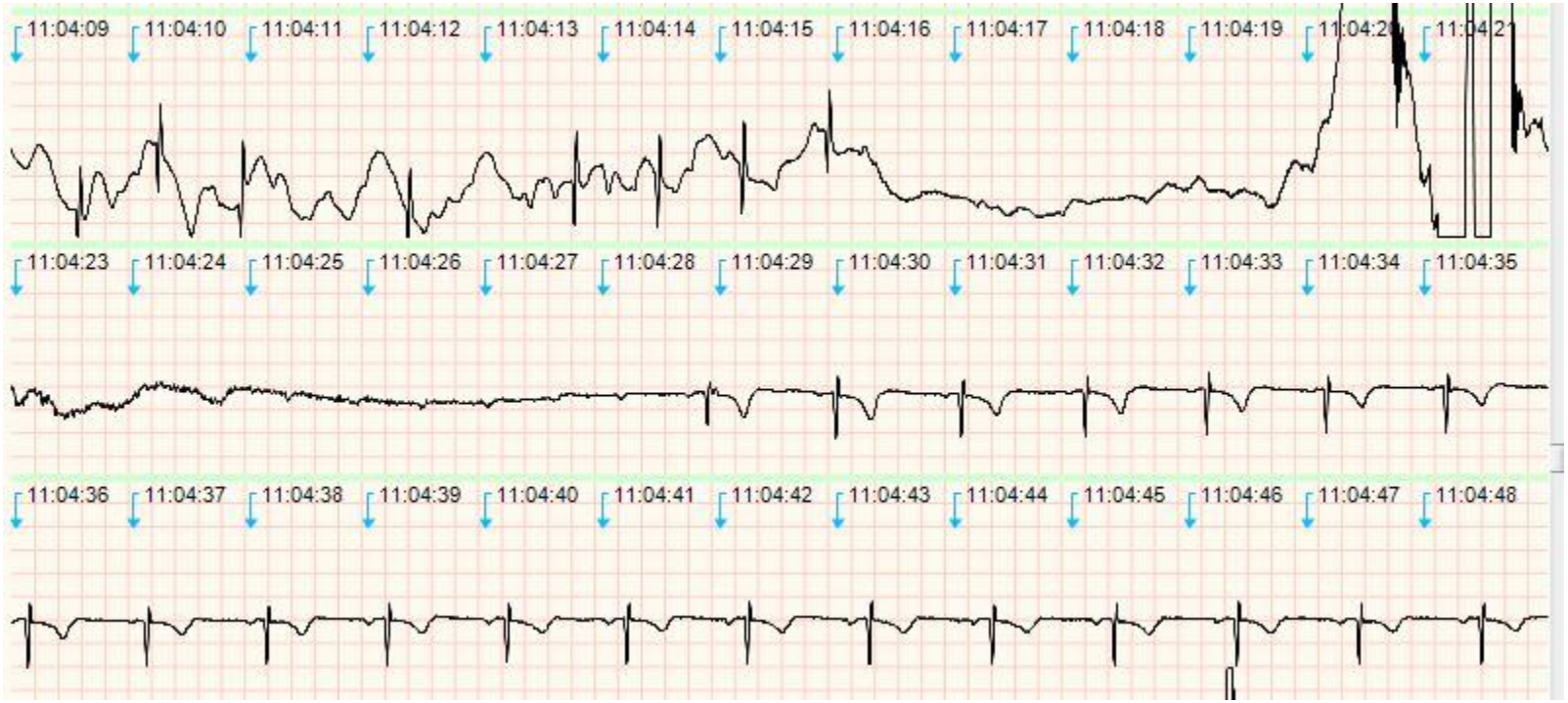
Technician:
Medications:



GE CASE V6.73 (0) Unconfirmed
25mm/s 10mm/mV 60Hz 0.01Hz FRF+ 12SL V21 HEART V5.4 Attending MD: Page 30

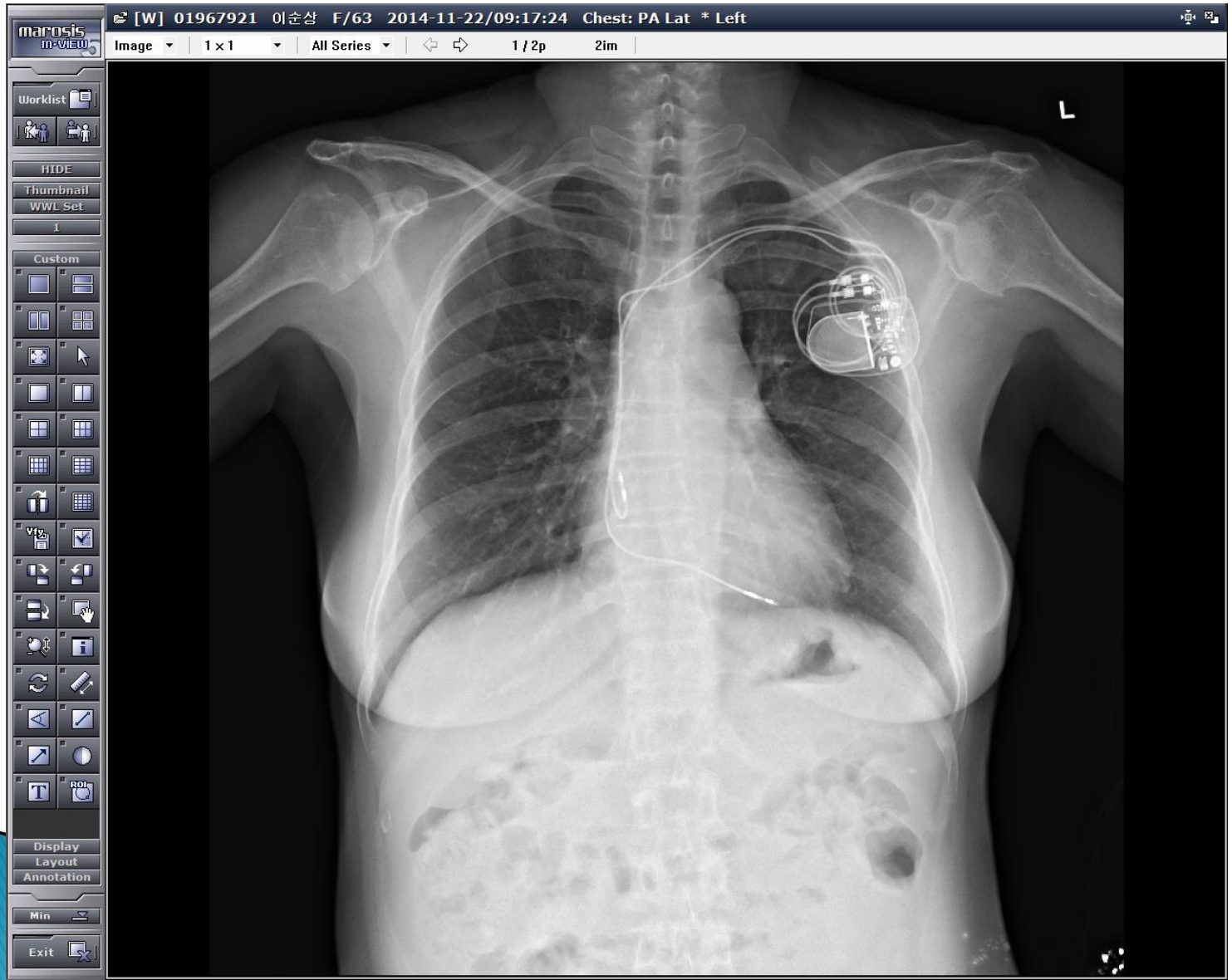
병동 환... 이순상(3... 영상 조회 병동 Ord... EMR조회 주치의 ... maroview 계산기 Microsoft... 오전 1:11

Heart call(14.11.17)



Heart call(14.11.17)

CXR(14.11.22)-post PMK



"우량농지 훼손 웬말이냐"

"쌀도 모자라는데 웬 고속도로"

"부유층의 전유물인 고속도로 결사반대"

공사현장에 몸소 들어 누워 진보, 개혁, 민주화 운동을 몸으로 실천하신 "움직이는 양심" 슨상님

DICOM

- 의료용 디지털 영상 및 통신 표준
  - **의료용 디지털 영상 및 통신**(Digital Imaging and Communications in Medicine, DICOM) **표준**은 의료용 기기에서 디지털 영상표현과 통신에 사용되는 여러 가지 표준을 총칭하는 말로, 미국방사선의학회(ACR)와 미국전기공업회(NEMA)에서 구성한 연합 위원회에서 발표한다.
- 역사[편집]
  - 미국방사선의학회와 미국전기공업회는 의료 영상 장비의 표준화를 위해 1983년 ACR-NEMA 디지털 영상전송 표준 위원회를 발족하였다. 1985년 ACR-NEMA 표준 버전 1.0(출판번호 300-1985)이 북미방사선학회(RSNA)에서 처음으로 발표되었으며, 이어 1988년에는 버전 2.0(출판번호 300-1988)이 발표되었다. 이후 객체지향 정보 모델을 사용하는 등 큰 수정이 가해지면서 새로운 명칭을 필요로 하게 되었고, 그 결과 1992년 북미방사선학회 회의에서 DICOM이라는 명칭의 표준이 처음으로 제안되었다. DICOM은 1993년 첫 데모 버전이 발표된 이후 지금까지 꾸준히 수정되고 있다.

SNOMED

- History[edit]
  - SNOMED was started in 1965 as a Systematized Nomenclature of Pathology (SNOP) and was further developed into a logic-based health care terminology.[6][7]
  - SNOMED CT was created in 1999 by the merger, expansion and restructuring of two large-scale terminologies: SNOMED Reference Terminology (SNOMED RT), developed by the College of American Pathologists (CAP); and the Clinical Terms Version 3 (CTV3) (formerly known as the Read codes), developed by theNational Health Service of the United Kingdom (NHS).[8][9] The final product was released in January 2002.

Clinical course of AMI

Chest pain at home

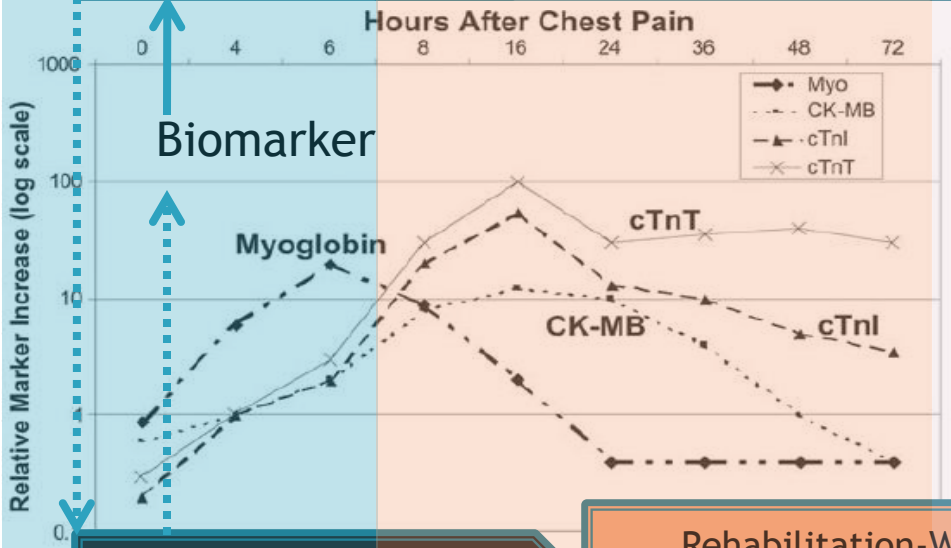
EKG at ER
ST elevation

Cardiac Rehabilitation
Monitoring

Re-admission

PCI

Discharge- Out of Hospital



Biomarker

Heart Failure
Chest pain-
Re-attack

ICD
CRT_D

Biomarker test
at home and ER

Rehabilitation-Wellness/Health promotion
•Exercise- Event Monitoring
•Food control

EKG monitoring (1,3,8 channel) at home and hospital

WCD

ICD
CRT_D

Cardiac Rehabilation

- Who?

Conclusion

- Whereas the first decade of research in the field of wearable technology was marked by an emphasis on the engineering work needed to develop wearable sensors and systems, recent studies have been focused on the application of such technology toward monitoring health and wellness.
- Consequently, we have witnessed a great deal of work toward the integration of wearable technologies and communication as well as data analysis technologies so that the goal of remote monitoring individuals in the home and community settings could be achieved. Besides, when monitoring has been performed in the home, researchers and clinicians have integrated ambient sensors in the remote monitoring systems.
- Research toward achieving remote monitoring of older adults and subjects undergoing clinical interventions will soon face the need for establishing business models to cover the costs and identify reimbursement mechanisms for the technology and its management.

감사합니다