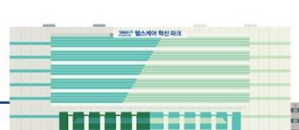
대한심부전학회
The Korean Society of Heart Failure

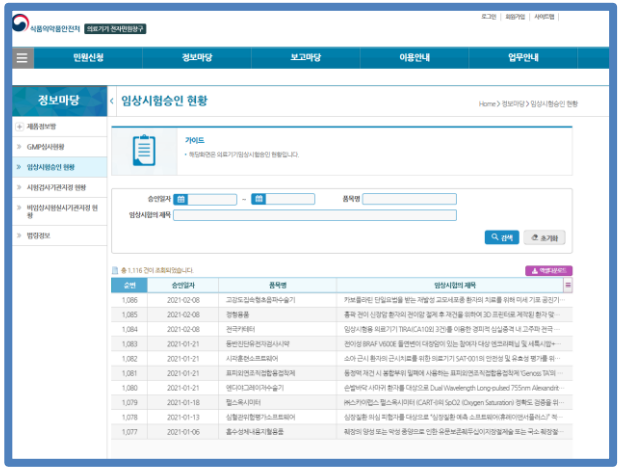
심혈관질환에서 인공지능 소프트웨어

Seoul National University
College of Medicine

Dong-Ju Choi, MD. PhD

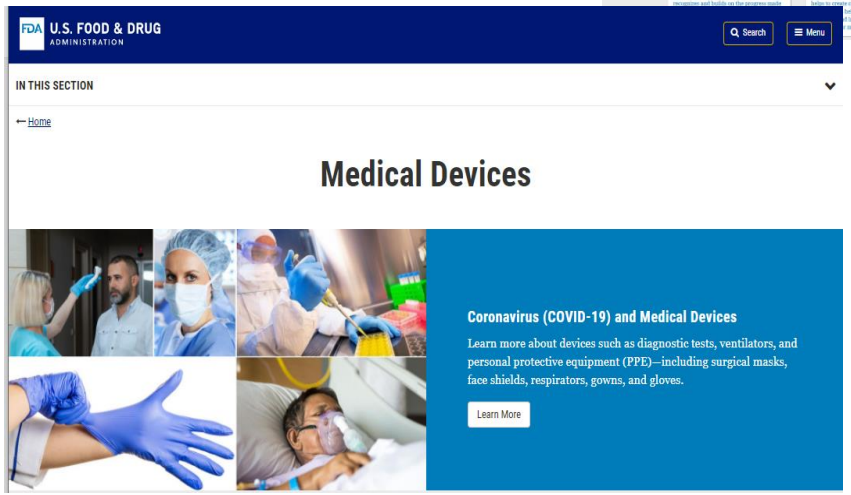


Introduction



Introduction

US FDA Medical Device



US FDA Digital Health

Introduction

US FDA (SaMD) Software as a Medica Device

FDA U.S. FOOD & DRUG ADMINISTRATION

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Software as a Medical Device (SaMD)

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Software as a Medical Device (SaMD)

- Artificial Intelligence and Machine Learning in Software as a Medical Device
- What are examples of Software as a Medical Device?
- Global Approach to Software as a Medical Device

As technology continues to advance all facets of health care, software has become an important part of all products, integrated widely into digital platforms that serve both medical and non-medical purposes. Software, which on its own is a medical device – Software as a Medical Device – is one of three types of software related to medical devices. The other two types of software related to medical devices include software that is integral to a medical device (Software in a medical device) and software used in the manufacture or maintenance of a medical device.

What is Software as a Medical Device?

The term Software as a Medical Device is defined by the International Medical Device Regulators Forum (IMDRF) as "**software intended to be used for one or more medical purposes that perform these purposes without being part of a hardware medical device.**"

Use of Software as a Medical Device is continuing to increase. It can be used across a broad range of technology platforms, including medical device platforms, commercial "off-the-shelf" platforms, and virtual networks, to name a few. Such software was previously referred to by industry, international regulators, and health care providers as "standalone software," "medical device software," and/or "health software," and can sometimes be confused with other types of software.

How are Regulators Addressing the Challenges with Software as a Medical Device?

US FDA (AI/ML SaMD) AI/ML Software as a Medica Device

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Software as a Medical Device (SaMD)

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Artificial Intelligence and Machine Learning (AI/ML) Software as a Medical Device Action Plan

The U.S. Food and Drug Administration (FDA) issued the "Artificial Intelligence/Machine Learning (AI/ML)-Based Software as a Medical Device (SaMD) Action Plan" from the Center for Devices and Radiological Health's Digital Health Center of Excellence.

The Action Plan is a direct response to stakeholder feedback to the April 2019 discussion paper, "Proposed Regulatory Framework for Modifications to Artificial Intelligence/Machine Learning-Based Software as a Medical Device" and outlines five actions the FDA intends to take.

Download Action Plan (PDF - 747 KB)

Content current as of: 01/12/2021

Regulated Product(s) Medical Devices

Introduction

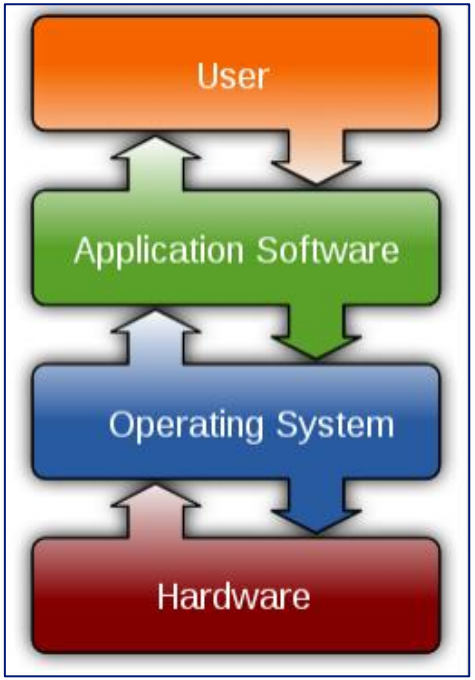
AI/ML SOFTWARE AS A MEDICAL DEVICE ACTION PLAN

1. Tailored Regulatory Framework for AI/ML-based SaMD
2. Good Machine Learning Practice (GMLP)
3. Patient-Centered Approach Incorporating Transparency to Users
4. Regulatory Science Methods Related to Algorithm Bias & Robustness
5. Real-World Performance (RWP)

What we heard: **Stakeholders described the need for clarity on Real-World Performance (RWP) monitoring for AI/ML software.**

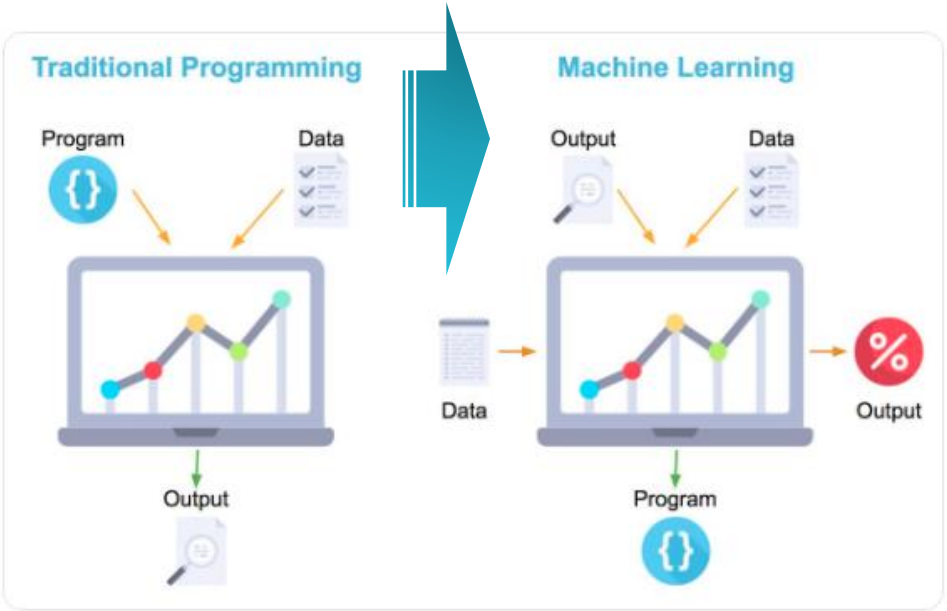
What we'll do: **Work with stakeholders who are piloting the RWP process for AI/ML-based SaMD**

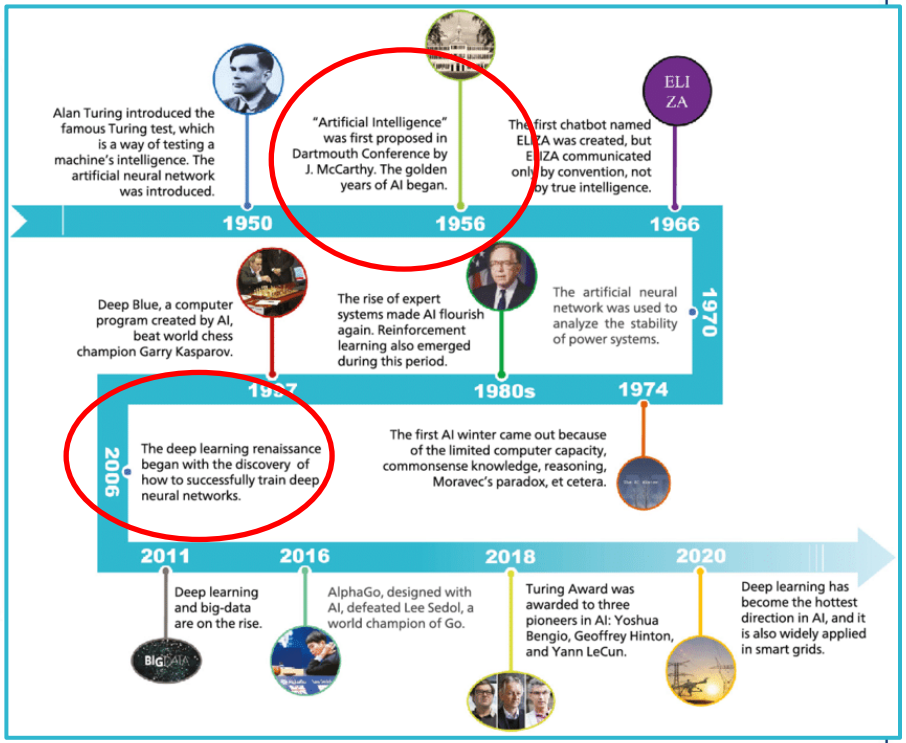
Softwarer is a collection of instructions and **data** that tell computer how to work, including computer programs, libraries, and related non-executable **data**, such as online documentation or digital media.



Introduction

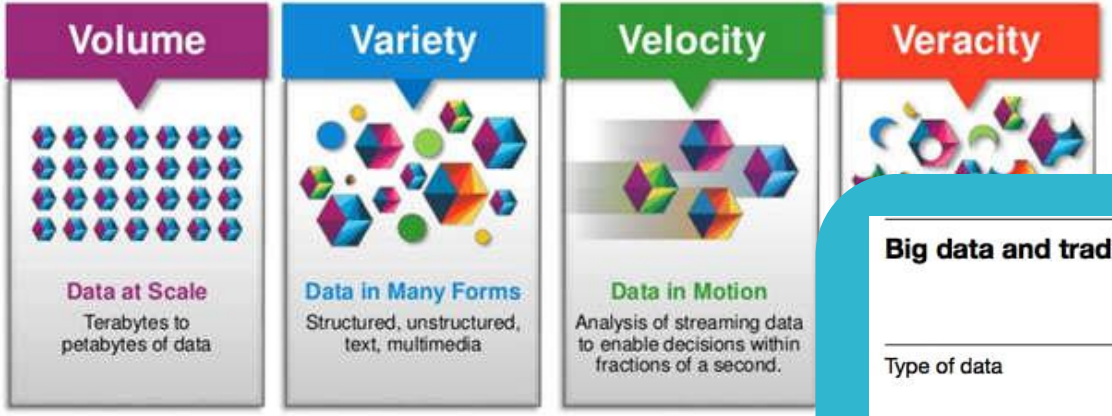
Software(traditional) vs. AI Software





Introduction

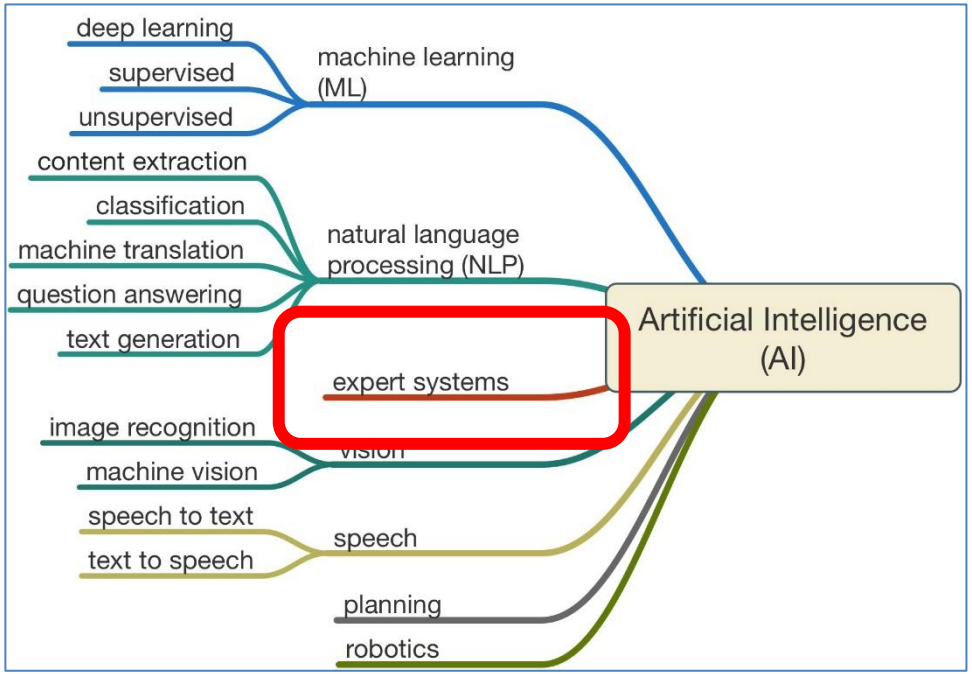
Traditional Data *vs.* Big Data

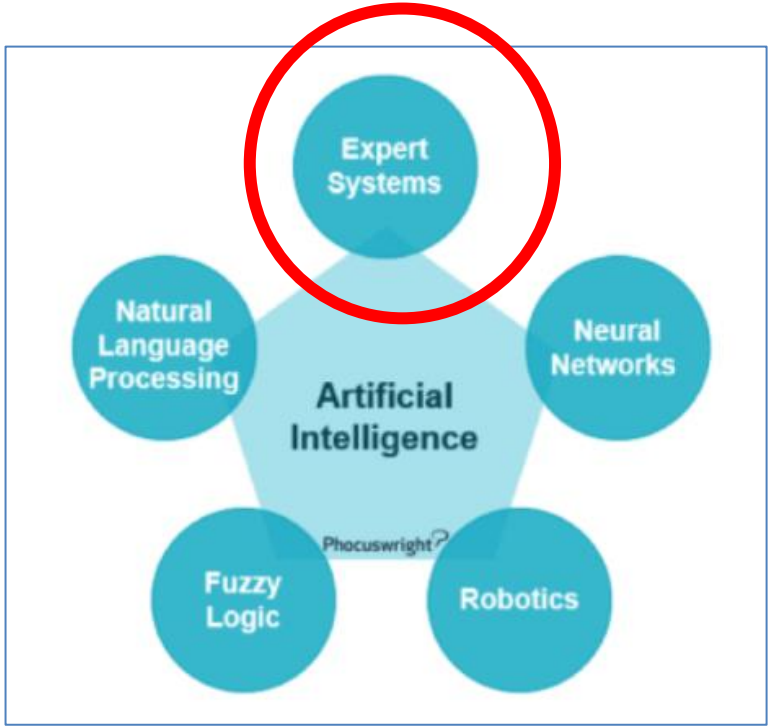


Big data and traditional analytics

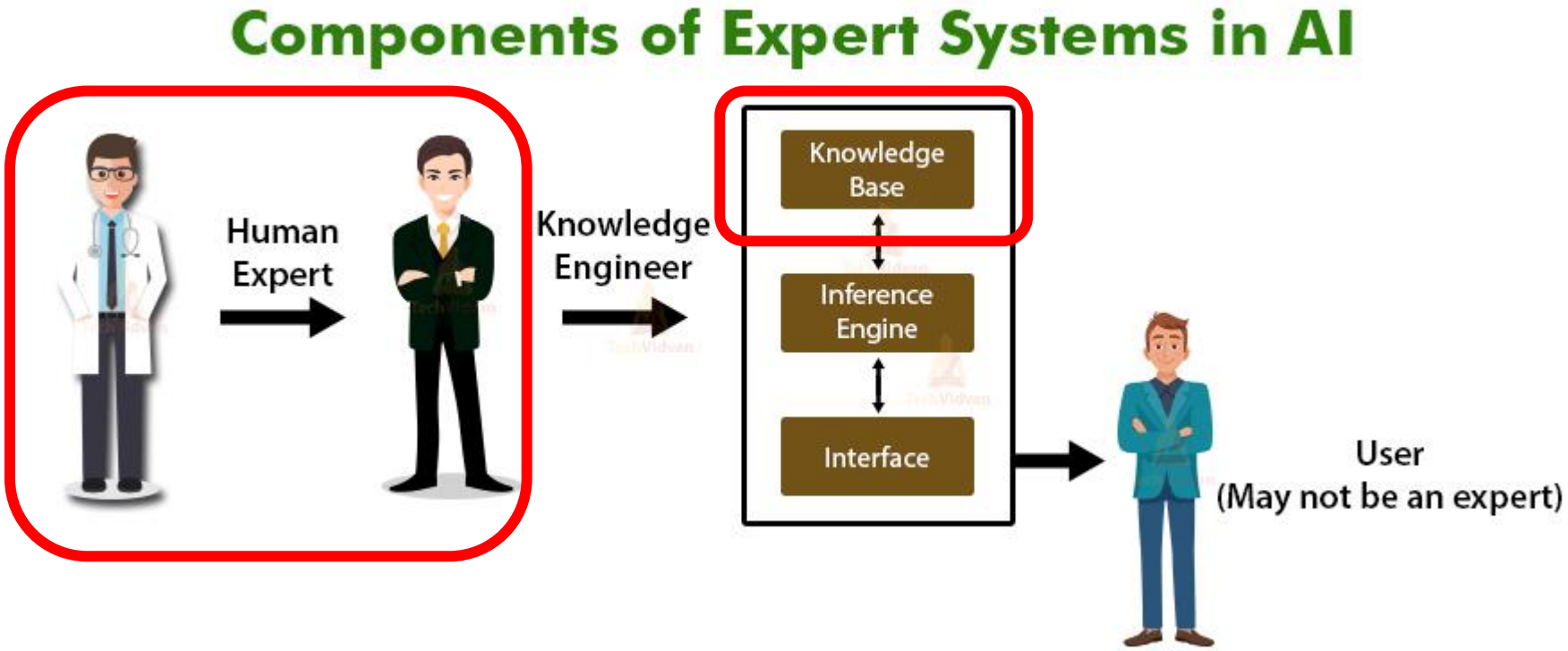
	Big data	Traditional analytics
Type of data	Unstructured formats	Formatted in rows and columns
Volume of data	100 terabytes to petabytes	Tens of terabytes or less
Flow of data	Constant flow of data	Static pool of data
Analysis methods	Machine learning	Hypothesis-based
Primary purpose	Data-based products	Internal decision support and services

Artificial Intelligence……?

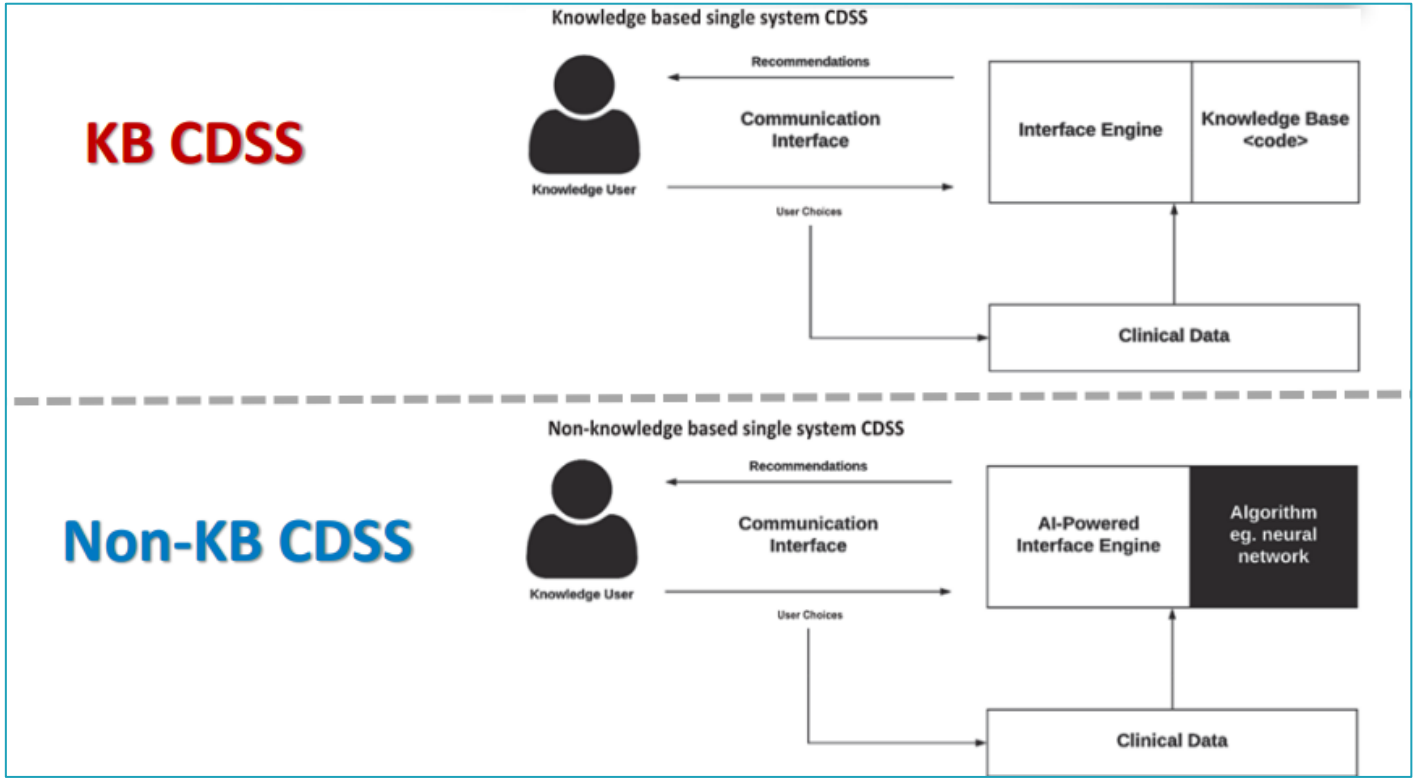




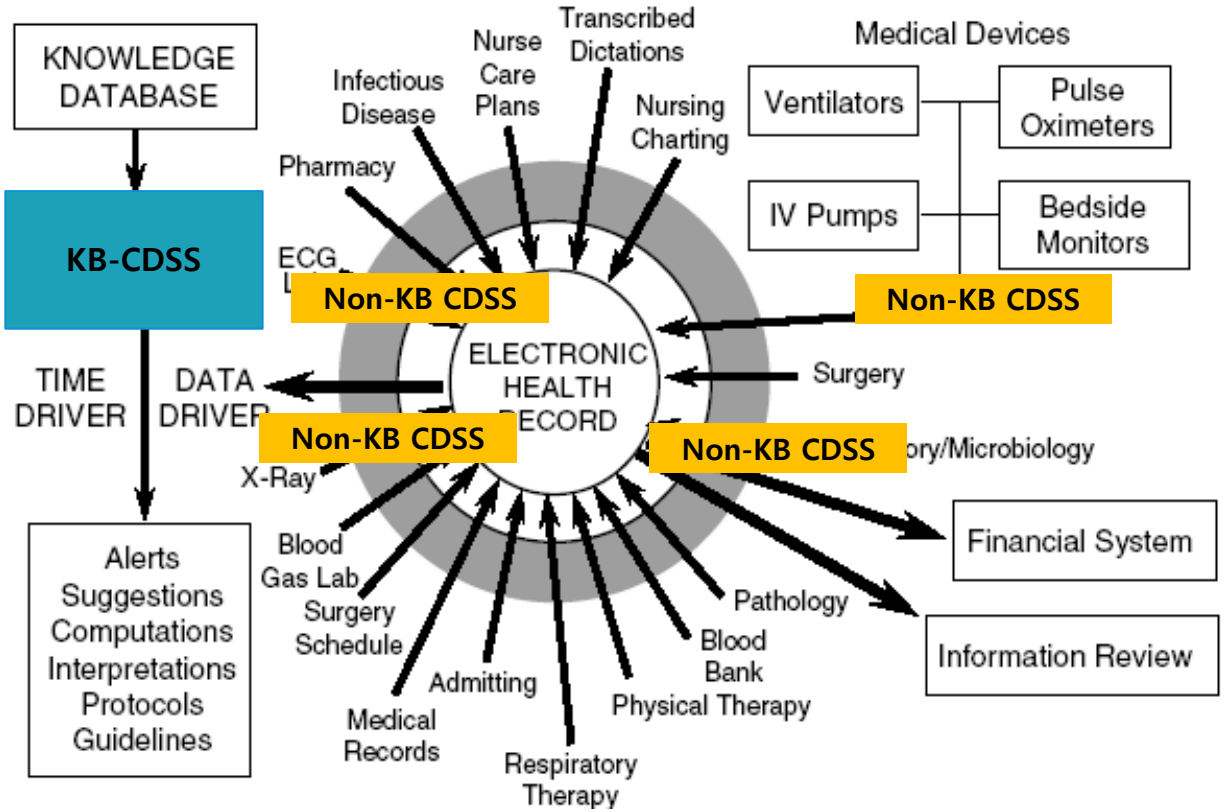
Expert System



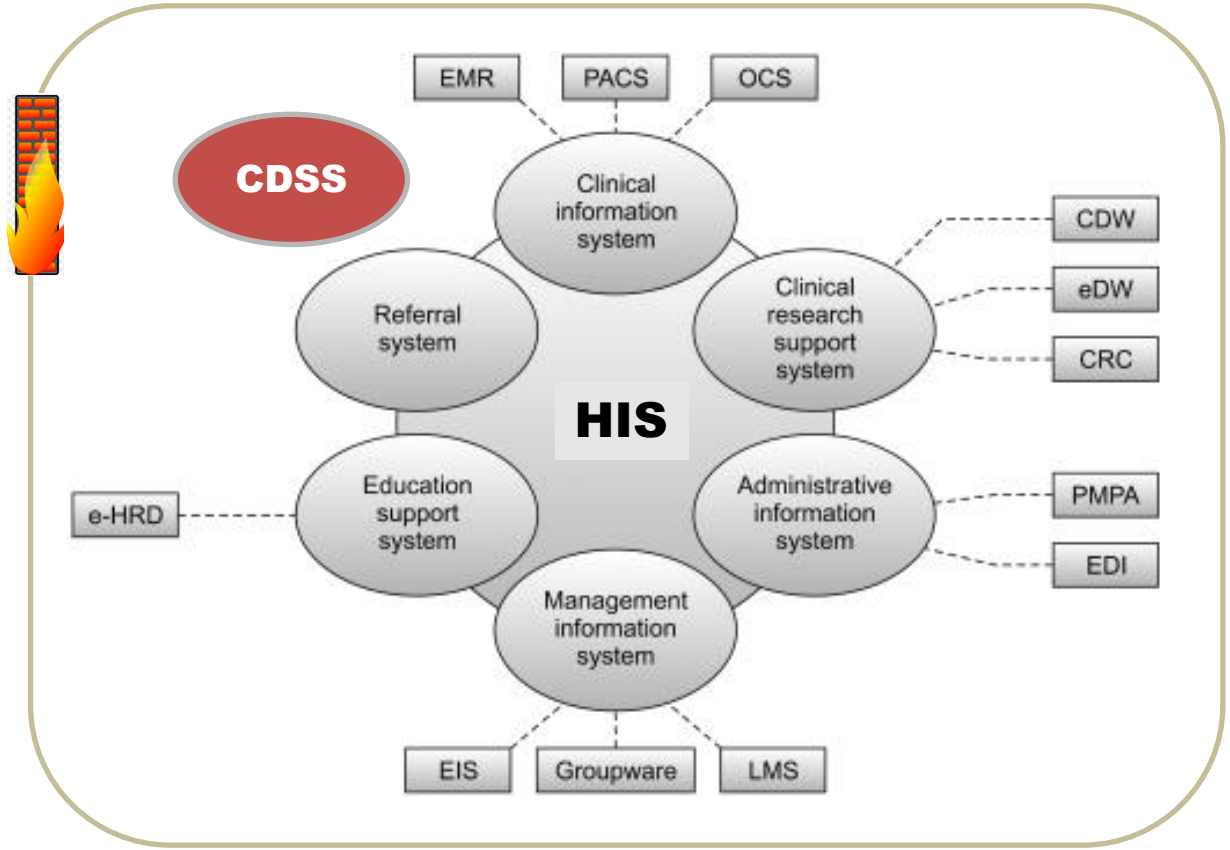
CDSS(Clinical Decision Supporting System)



CDSS(Clinical Decision Supporting System)



CDSS and HIS


EMR
PACS
OCS
CDSS
Clinical information system
Referral system
Clinical research support system
CDW
eDW
CRC
HIS
e-HRD
Education support system
Administrative information system
PMPA
EDI
Management information system
EIS
Groupware
LMS

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기업

금융·핀테크

"14개월 만에 숙원 풀었다"...데이터3법 본회의 통과

유진상 기자 차현아 기자

입력 2020.01.09 21:45

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데이터 경제 활성화를 위해 정부가 추진하는 데이터3법(개인정보보호법, 신용정보법, 정보통신망법 등 일명 개·망·신법)이 본회의를 통과했다. 업계가 강력하게 통과를 요청해 왔던 숙원이 해결됐다. 법안이 발의된지 1년 2개월만이다. 이에 따라 4차 산업혁명 관련 산업이 대거 수혜를 볼 수 있을 전망이다.

데이터 3법 '가명정보' 결합전문기관 늘린다

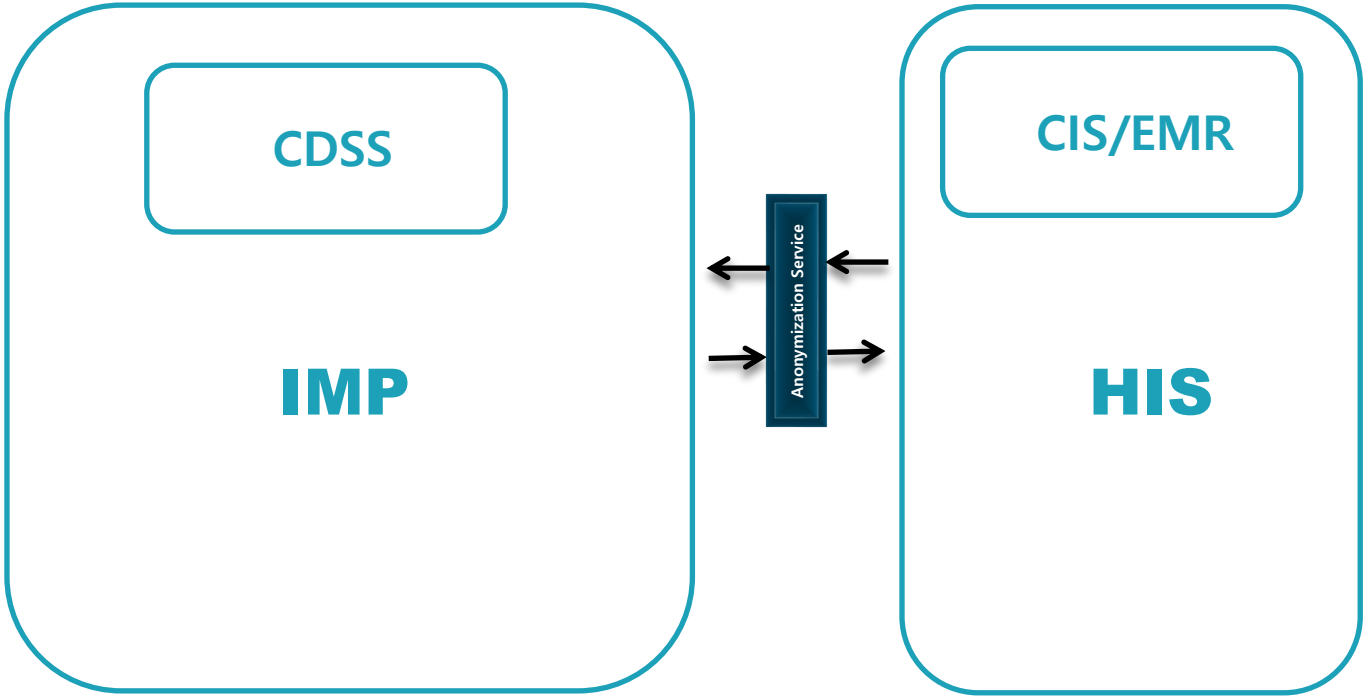
발행일 : 2021.07.28 18:00

URL

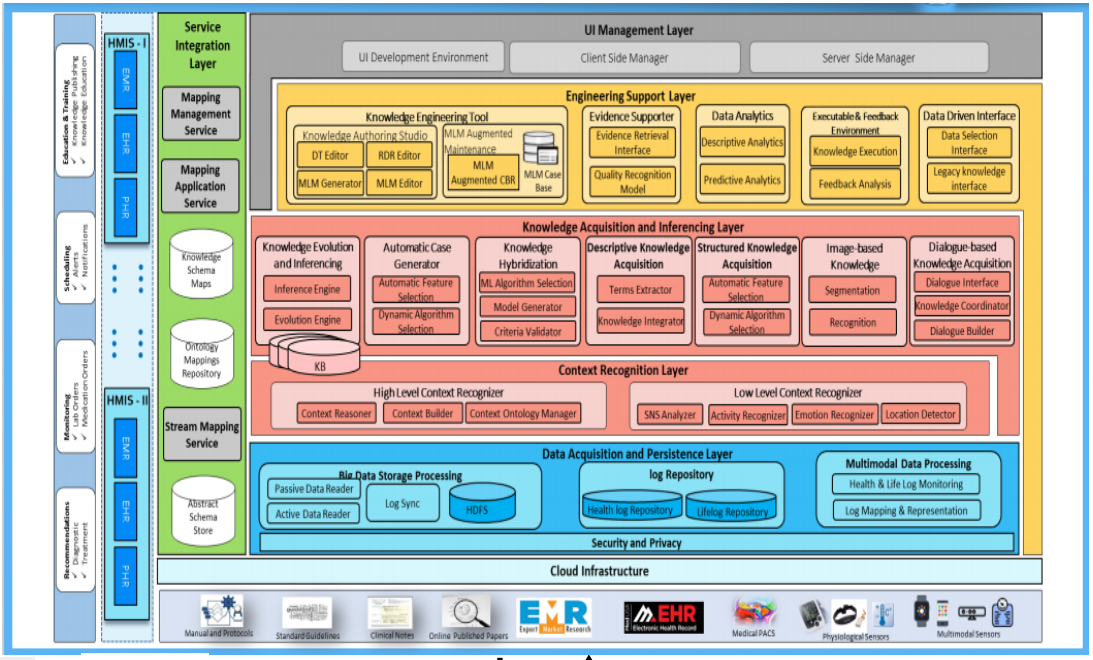
ㄴ빚더미에 벼랑 끝 내몰린 중년층.. 이것으로 걱정 해결!

김부겸 총리, 지원센터 개소식 참석
올해 27곳으로 작년比 3배 확충
결합 기간은 기존보다 절반 단축
기관 역할도 결합 全 단계로 강화

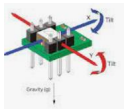
IMP(Intelligent Medical Platform) vs. CDSS



IMP(Intelligent Medical Platform)



Anonymization Service

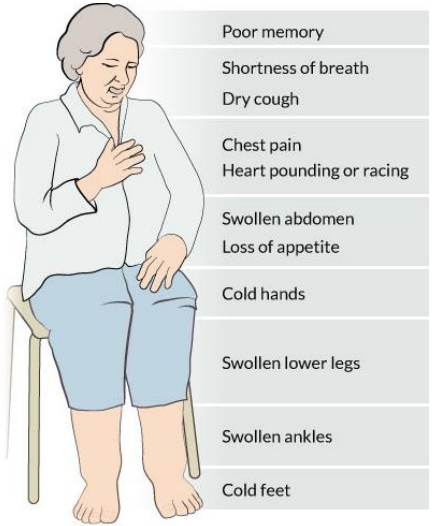


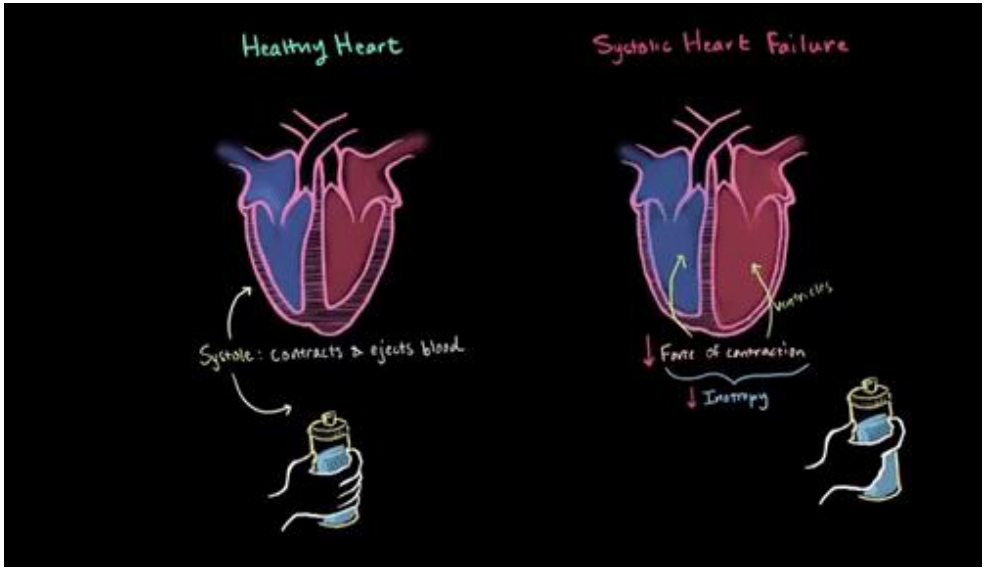
HIS

AI-CDSS in Hospital Setting

Heart Failure Silo in IMP

Heart Failure
심부전





Heart Failure Silo in IMP

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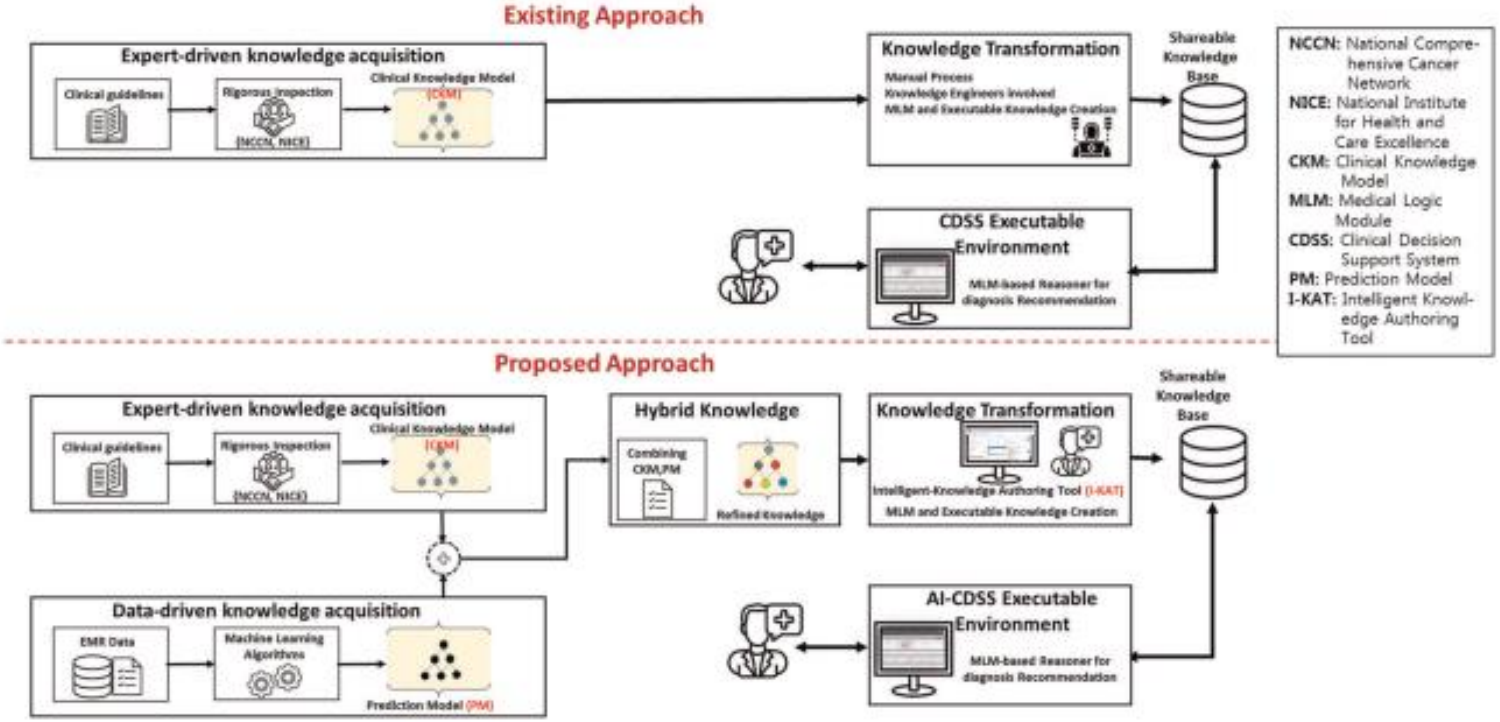
Artificial intelligence for the diagnosis of heart failure

Dong-Ju Choi[1,3]✉, Jin Joo Park[1,3], Taqdir Ali[2] and Sungyoung Lee[2]✉

The diagnosis of heart failure can be difficult, even for heart failure specialists. Artificial Intelligence-Clinical Decision Support System (AI-CDSS) has the potential to assist physicians in heart failure diagnosis. The aim of this work was to evaluate the diagnostic accuracy of an AI-CDSS for heart failure. AI-CDSS for cardiology was developed with a hybrid (expert-driven and machine-learning-driven) approach of knowledge acquisition to evolve the knowledge base with heart failure diagnosis. A retrospective cohort of 1198 patients with and without heart failure was used for the development of AI-CDSS (training dataset, $n = 600$) and to test the performance (test dataset, $n = 598$). A prospective clinical pilot study of 97 patients with dyspnea was used to assess the diagnostic accuracy of AI-CDSS compared with that of non-heart failure specialists. The concordance rate between AI-CDSS and heart failure specialists was evaluated. In retrospective cohort, the concordance rate was 98.3% in the test dataset. The concordance rate for patients with heart failure with reduced ejection fraction, heart failure with mid-range ejection fraction, heart failure with preserved ejection fraction, and no heart failure was 100%, 100%, 99.6%, and 91.7%, respectively. In a prospective pilot study of 97 patients presenting with dyspnea to the outpatient clinic, 44% had heart failure. The concordance rate between AI-CDSS and heart failure specialists was 98%, whereas that between non-heart failure specialists and heart failure specialists was 76%. In conclusion, AI-CDSS showed a high diagnostic accuracy for heart failure. Therefore, AI-CDSS may be useful for the diagnosis of heart failure, especially when heart failure specialists are not available.

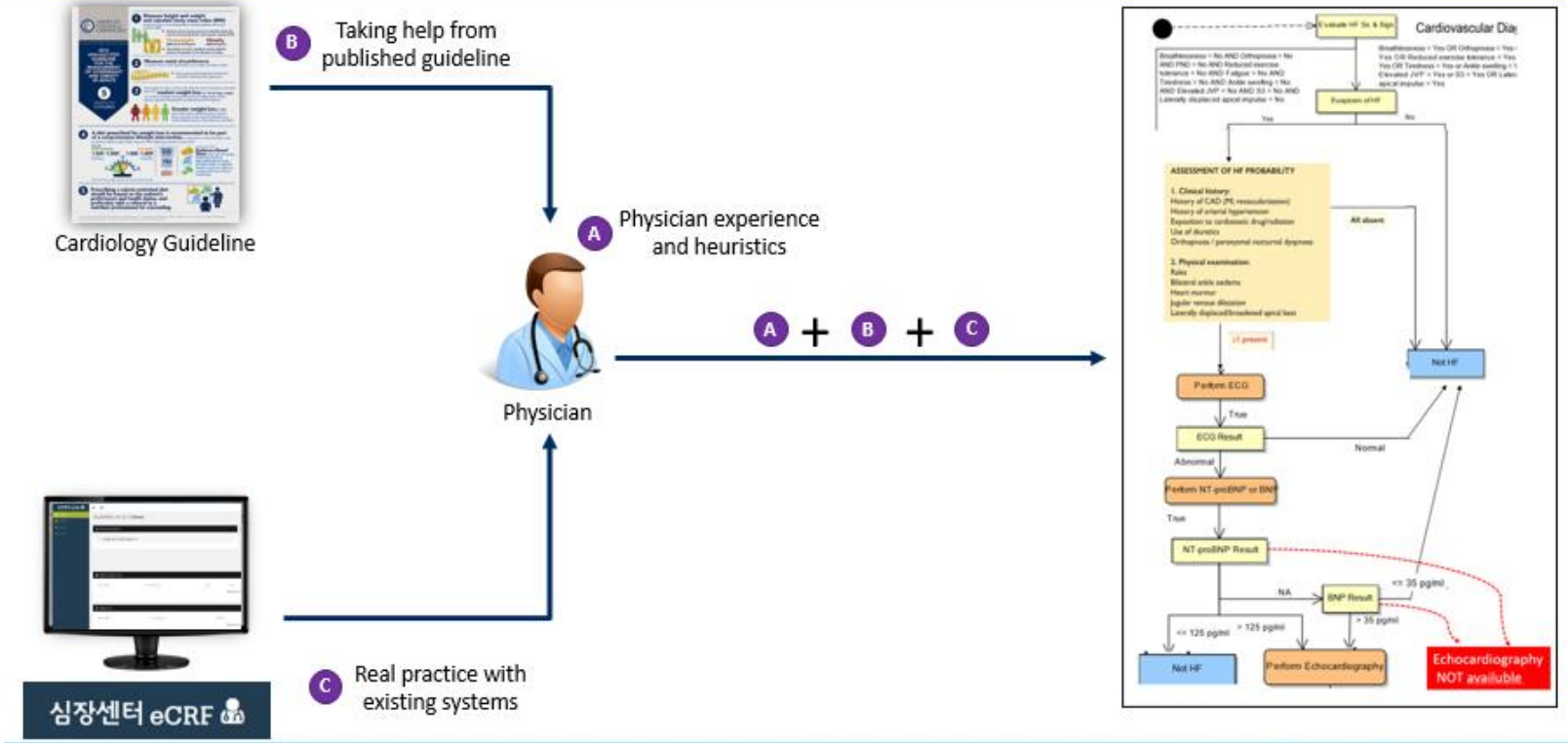
npj Digital Medicine (2020)3:54; https://doi.org/10.1038/s41746-020-0261-3

Heart Failure Silo in IMP
(Hybrid Knowledge-base Expert system CDSS)



Heart Failure Silo in IMP

Stage 1: Knowledge Acquisition



Data

Heart Failure Silo in IMP

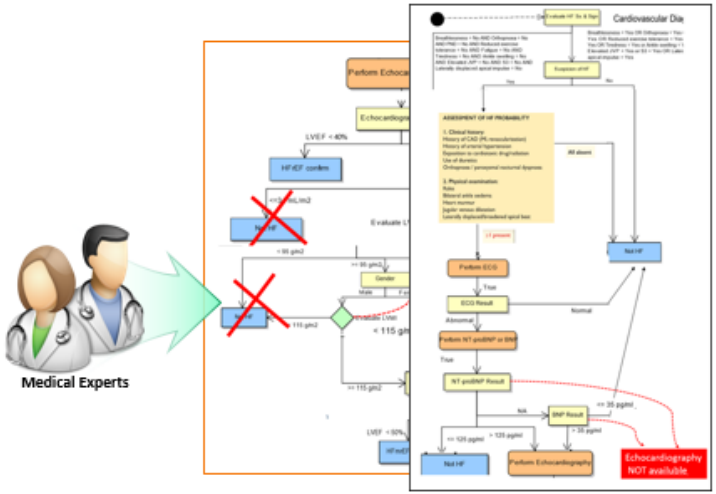
Stage 1: Knowledge Acquisition: 14 attributes

S. No.	Attribute Name	Attribute Description
1	Signs & Symptoms	Patient has some sign and symptom like, breathlessness, exercise tolerance, tiredness, ankle swelling, and nocturnal cough.
2	Clinical History	It checks the patient history such as coronary artery disease (CAD), arterial hypertension, exposition to cardio toxic drug/radiation, use of diuretics, orthopnea.
3	Physical Examination	In this category, physicians check rales, bilateral ankle edema, heart murmur, jugular venous dilatation, laterally displaced apical beat.
4	ECG Result	Noninvasive test to check how fast the heat beats, it may be normal or abnormal.
5	BNP Result	B-type natriuretic peptide (BNP) blood test measures the levels of the BNP hormone in patients' blood.
6	NT-proBNP Result	N-terminal pro-B-type natriuretic peptide level
7	Left Ventricular Ejection Fraction (LVEF)	It finds total amount of blood in the left ventricle is pumped out with each heartbeat.
8	Left Atrial Volume Index (LAVI)	Measure to evaluate the LA size
9	E/e'	Measure to evaluate the diastolic function
10	e' Septal	Measure to evaluate the diastolic function
11	Longitudinal strain	Measure to evaluate myocardial contractility
12	Tricuspid Regurgitation Velocity (TRV)	TRV has been shown to correlate with pulmonary artery systolic pressure (PASP) at rest (1–3) and with exercise (3–7).
13	Left Ventricular Mass Index (LVMI)	Measure to evaluate the LV size
14	Gender	The state of being male or female

Heart Failure Silo in IMP

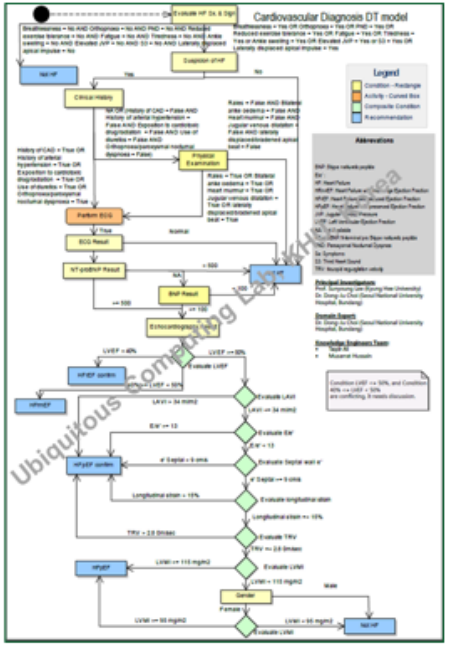
Stage 2: Knowledge Modeling

Mind Map



Enterprise Architect

Decision Tree

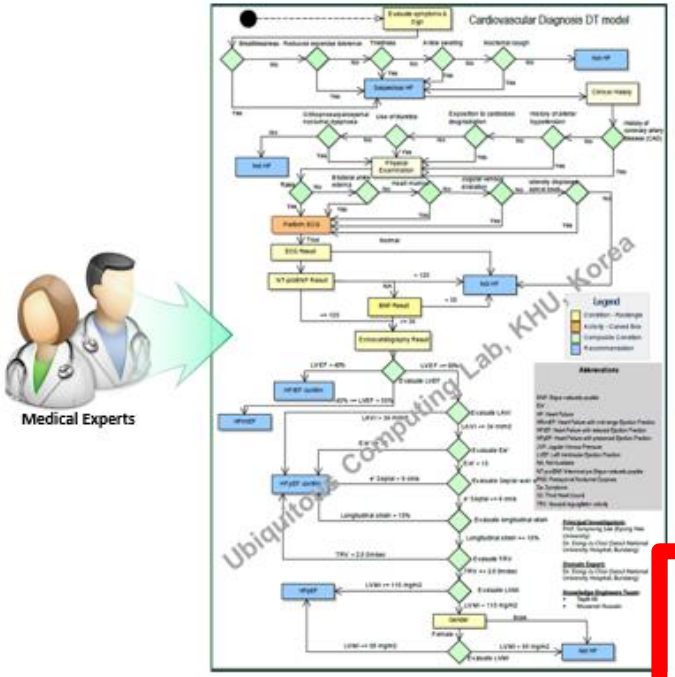


Ubiquitous Computing Lab KHU

Heart Failure Silo in IMP

Stage 3: Knowledge Rules Creation (Expert-Driven)

Decision Tree



Intelligent Knowledge Authoring Tool (I-KAT)

Production Rules

Rule #	RuleTitle	SymptomsAndSigns	ClinicalHistory	PhysicalExam	ECG	NTproBNP	BNP	LVEF
1	CardiovascularRule-1	0	-	-	-	-	-	-
2	CardiovascularRule-2	1	-	-	-	-	-	-
3	CardiovascularRule-3	1	0	-	-	-	-	-
4	CardiovascularRule-4	1	1	0	-	-	-	-
5	CardiovascularRule-5	1	1	1	0	-	-	-
6	CardiovascularRule-6	1	1	1	1	< :125	-	-
7	CardiovascularRule-7	1	1	1	1	-	< :35	-
8	CardiovascularRule-8	1	1	1	1	-	>=:35	<:40
9	CardiovascularRule-9	1	1	1	1	-	>=:35	( ):39 & 50
10	CardiovascularRule-10	1	1	1	1	-	>=:35	>=:50
11	CardiovascularRule-11	1	1	1	1	-	>=:35	>=:50
12	CardiovascularRule-12	1	1	1	1	-	>=:35	>=:50
13	CardiovascularRule-13	1	1	1	1	-	>=:35	>=:50
14	CardiovascularRule-14	1	1	1	1	-	>=:35	>=:50
15	CardiovascularRule-15	1	1	1	1	-	>=:35	>=:50
16	CardiovascularRule-16	1	1	1	1	-	>=:35	>=:50
17	CardiovascularRule-17	1	1	1	1	-	>=:35	>=:50
18	CardiovascularRule-18	1	1	1	1	-	>=:35	>=:50
19	CardiovascularRule-19	1	1	1	1	>= :125	-	<:40
20	CardiovascularRule-20	1	1	1	1	>= :125	-	( ):39 & 50
21	CardiovascularRule-21	1	1	1	1	>= :125	-	>=:50
22	CardiovascularRule-22	1	1	1	1	>= :125	-	>=:50
23	CardiovascularRule-23	1	1	1	1	>= :125	-	>=:50
24	CardiovascularRule-24	1	1	1	1	>= :125	-	>=:50

LAVI	Ee	eSeptal	LongitudinalStrain	TRV	LVMI	Gender	DiagnosisRecommendation	TreeReferencePath
-	-	-	-	-	-	-	Not HF	Cardio_D_1
-	-	-	-	-	-	-	Suspecious HF	Cardio_D_2
-	-	-	-	-	-	-	Not HF	Cardio_D_3
-	-	-	-	-	-	-	Not HF	Cardio_D_4
-	-	-	-	-	-	-	Not HF	Cardio_D_5
-	-	-	-	-	-	-	Not HF	Cardio_D_6
-	-	-	-	-	-	-	Not HF	Cardio_D_7
-	-	-	-	-	-	-	HFrEF confirm	Cardio_D_8
-	-	-	-	-	-	-	HFrmEF	Cardio_D_9
>:34	-	-	-	-	-	-	HF pEF confirm	Cardio_D_10
<=:34	>=:13	-	-	-	-	-	HF pEF confirm	Cardio_D_11
<=:34	<:13	<:9	-	-	-	-	HF pEF confirm	Cardio_D_12
<=:34	<:13	>=:9	>:15	-	-	-	HF pEF confirm	Cardio_D_13
<=:34	<:13	>=:9	=<:15	> :2.80	-	-	HF pEF confirm	Cardio_D_14
<=:34	<:13	>=:9	=<:15	=< :2.80	>= :115	-	HFpEF	Cardio_D_15
<=:34	<:13	>=:9	=<:15	=< :2.80	< :115	Male	Not HF	Cardio_D_16
<=:34	<:13	>=:9	=<:15	=< :2.80	< :95	Female	Not HF	Cardio_D_17
<=:34	<:13	>=:9	=<:15	=< :2.80	>=:95	Female	HFpEF	Cardio_D_18
-	-	-	-	-	-	-	HFrEF confirm	Cardio_D_19
-	-	-	-	-	-	-	HFrmEF	Cardio_D_20

Total Rules: 1309
Total Patient Data : 300
Initial Accuracy : 90%

Heart Failure Silo in IMP

Stage 4: 2nd Knowledge Modeling (Data-Driven)

Contributing Factors:

(Heart Failure Diagnosis)

Patient Dataset: 1000

EMR/HMIS

ID	Age	Gender	Symptoms & Sign (If 1 or more=1, NO=0	Clinical History (If 1 or more=1, NO=0	Physical Exam (If 1 or more=1, NO=0	ECG (normal=0, abnorma=1)	NT-proBNP	BNP	LVEF	LAVI	LVMI	E/e'	e' septal	TRV	Longitudinal strain(GLS)
10611919	79	M	1	0	0	0	185.3			37		7.38	6.1	2.5	
11066473	63	M	1	1	0	0	209			39	62.01	8.31	6.74		
11264619	41	F	0	0	0	0	327.8		61.54	23.67	83.4	6.1	10.82	14.5	
13401793	82	M	1	0	0	1	185.4		60.98		90.96	6.54	8.1		19.3
15072850	82	M	1	1	0	1	177.2		55		54.78	5.32	9.4		
16805356	71	M	1	0	1	1	380.2		52.94		102.4	5.89	10.7	2.5	16.6
18411764	26	M	1	1	0	1	203.4		65.75	18.08	86.07	5.08	11.8		12
20659893	83	F	1	1	1	0	156.2		60.56	33.09	82.15	11.25	4.8	2.6	
26190107	78	F	1	0	0	0	201.6		56.1	31.54	83.92	10.44	4.5	2.6	18
26289425	34	F	1	1	0	1	1447.6		55.56	33.56	67.11	7.89	12.3	2.3	
27645097	84	M	1	1	0	0	164.6		62.5	33.89	95.64	12.24	6.7	2.8	
27691432	68	M	1	0	0	0	321.6		65.38		65.57	6.87	8.3	2.7	20.3

Machine Learning Algorithms

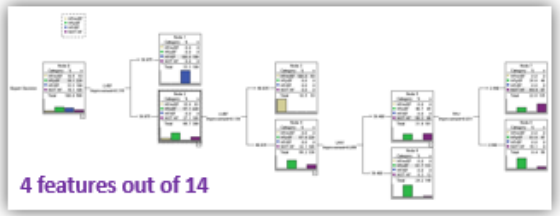
rapidminer

Black box Algorithms

- Naïve Bayes = 77%
- Generalized Linear Model = 74%
- Deep Learning = 80%

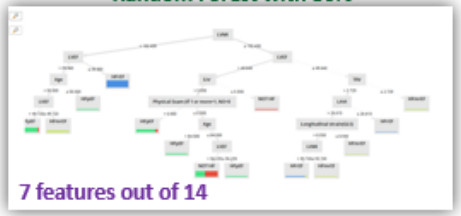
White box Algorithms

CRT with 88.55%



4 features out of 14

Random Forest with 86%



7 features out of 14

Decision Tree with 82%

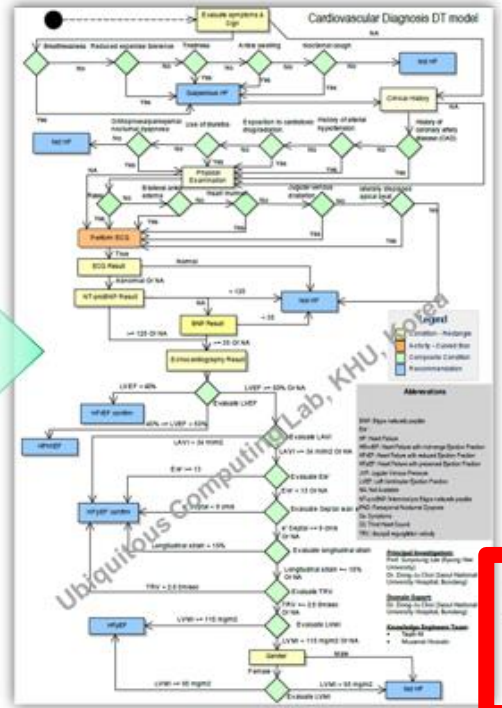
3 feature out of 14

Heart Failure Silo in IMP

Stage 5: Knowledge Rules Creation (Data + Expert-Driven)

Medical Experts

Decision Tree



Intelligent Knowledge Authoring Tool (I-KAT)

Production Rules

Rule #	RuleTitle	SymptomsAndSigns	ClinicalHistory	PhysicalExam	ECG	NTproBNP	BNP	LVEF
1	CardiovascularRule-1	0	-	-	-	-	-	-
2	CardiovascularRule-2	1	-	-	-	-	-	-
3	CardiovascularRule-3	1	0	-	-	-	-	-
4	CardiovascularRule-4	1	1	0	-	-	-	-
5	CardiovascularRule-5	1	1	1	0	-	-	-
6	CardiovascularRule-6	1	1	1	1	< 125	-	-
7	CardiovascularRule-7	1	1	1	1	-	< 35	-
8	CardiovascularRule-8	1	1	1	1	-	>=35	<40
9	CardiovascularRule-9	1	1	1	1	-	>=35	( )39 & 50
10	CardiovascularRule-10	1	1	1	1	-	>=35	>=50
11	CardiovascularRule-11	1	1	1	1	-	>=35	>=50
12	CardiovascularRule-12	1	1	1	1	-	>=35	>=50
13	CardiovascularRule-13	1	1	1	1	-	>=35	>=50
14	CardiovascularRule-14	1	1	1	1	-	>=35	>=50
15	CardiovascularRule-15	1	1	1	1	-	>=35	>=50
16	CardiovascularRule-16	1	1	1	1	-	>=35	>=50
17	CardiovascularRule-17	1	1	1	1	-	>=35	>=50
18	CardiovascularRule-18	1	1	1	1	-	>=35	>=50
19	CardiovascularRule-19	1	1	1	1	>= 125	-	<40
20	CardiovascularRule-20	1	1	1	1	>= 125	-	( )39 & 50
21	CardiovascularRule-21	1	1	1	1	>= 125	-	>=50
22	CardiovascularRule-22	1	1	1	1	>= 125	-	>=50
23	CardiovascularRule-23	1	1	1	1	>= 125	-	>=50
24	CardiovascularRule-24	1	1	1	1	>= 125	-	>=50

LAVI	Ee	eSeptal	LongitudinalStrain	TRV	LVMI	Gender	DiagnosisRecommendation	TreeReferencePath
-	-	-	-	-	-	-	Not HF	Cardio_D_1
-	-	-	-	-	-	-	Suspecious HF	Cardio_D_2
-	-	-	-	-	-	-	Not HF	Cardio_D_3
-	-	-	-	-	-	-	Not HF	Cardio_D_4
-	-	-	-	-	-	-	Not HF	Cardio_D_5
-	-	-	-	-	-	-	Not HF	Cardio_D_6
-	-	-	-	-	-	-	Not HF	Cardio_D_7
-	-	-	-	-	-	-	HFrEF confirm	Cardio_D_8
-	-	-	-	-	-	-	HFrmEF	Cardio_D_9
>=34	-	-	-	-	-	-	HF pEF confirm	Cardio_D_10
<=34	>=13	-	-	-	-	-	HF pEF confirm	Cardio_D_11
<=34	<13	<9	-	-	-	-	HF pEF confirm	Cardio_D_12
<=34	<13	>=9	>15	-	-	-	HF pEF confirm	Cardio_D_13
<=34	<13	>=9	=< 15	> 2.80	-	-	HF pEF confirm	Cardio_D_14
<=34	<13	>=9	=< 15	=< 2.80	>= 115	-	HFpEF	Cardio_D_15
<=34	<13	>=9	=< 15	=< 2.80	< 115	Male	Not HF	Cardio_D_16
<=34	<13	>=9	=< 15	=< 2.80	< 95	Female	Not HF	Cardio_D_17
<=34	<13	>=9	=< 15	=< 2.80	>=95	Female	HFpEF	Cardio_D_18
-	-	-	-	-	-	-	HFrEF confirm	Cardio_D_19
-	-	-	-	-	-	-	HFrmEF	Cardio_D_20

Total Rules: 15409
Total Patient Data : 600
Final Accuracy : 98.3%

Heart Failure Silo in IMP

Stage 6: Implementation

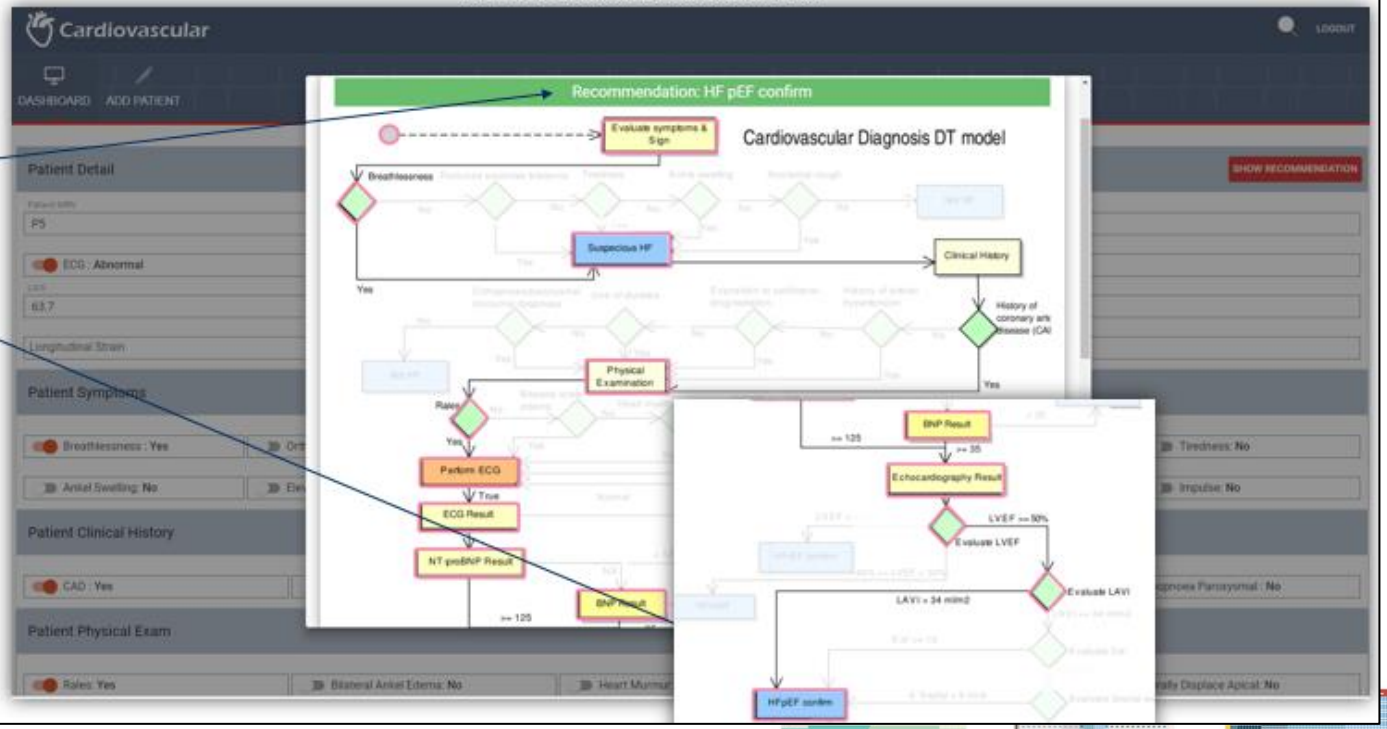
Login Screen: Only authorized physicians can be logged in to the system

CDSS Intervention: Shows the recommendation of a patient based on patient profile and symptoms

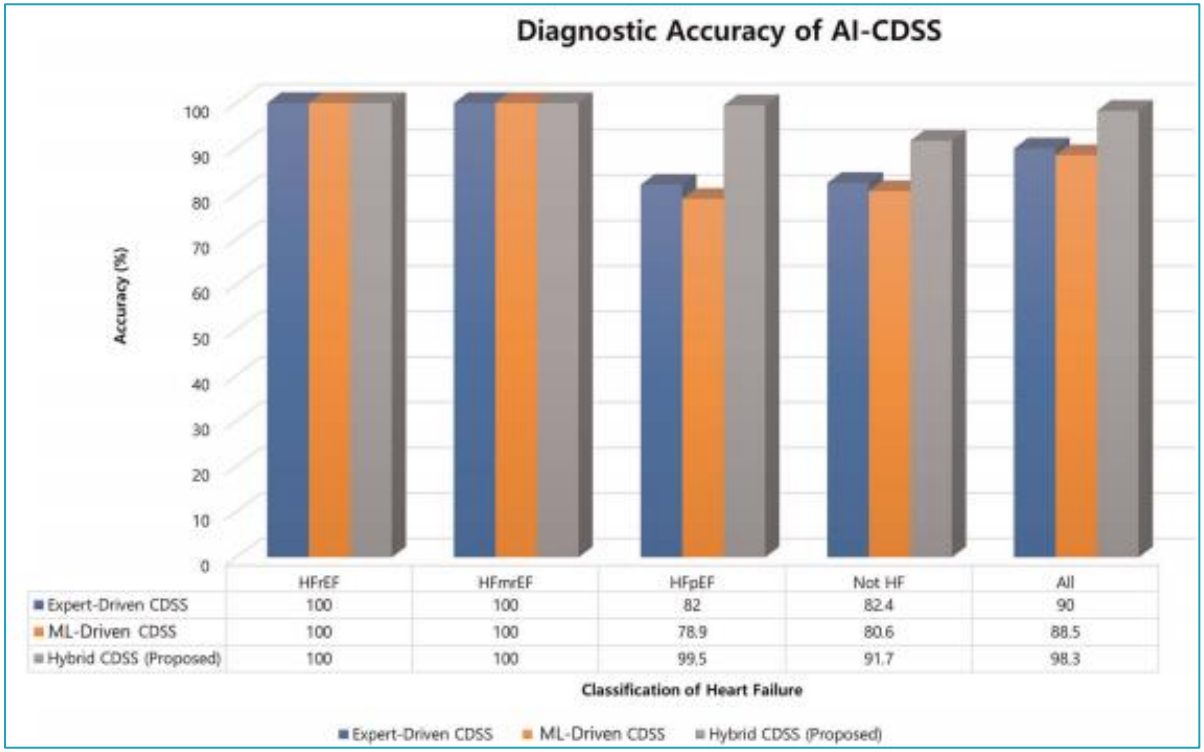
The decision comes from knowledge base

Final Decision

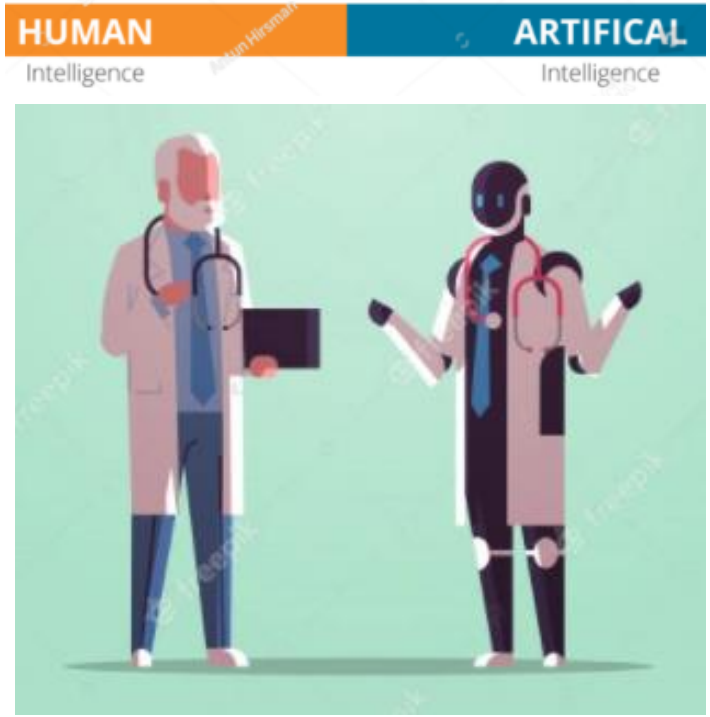
Knowledge Rule triggered



Validation of AI-CDSS: retrospective test set



Heart Failure Silo in IMP

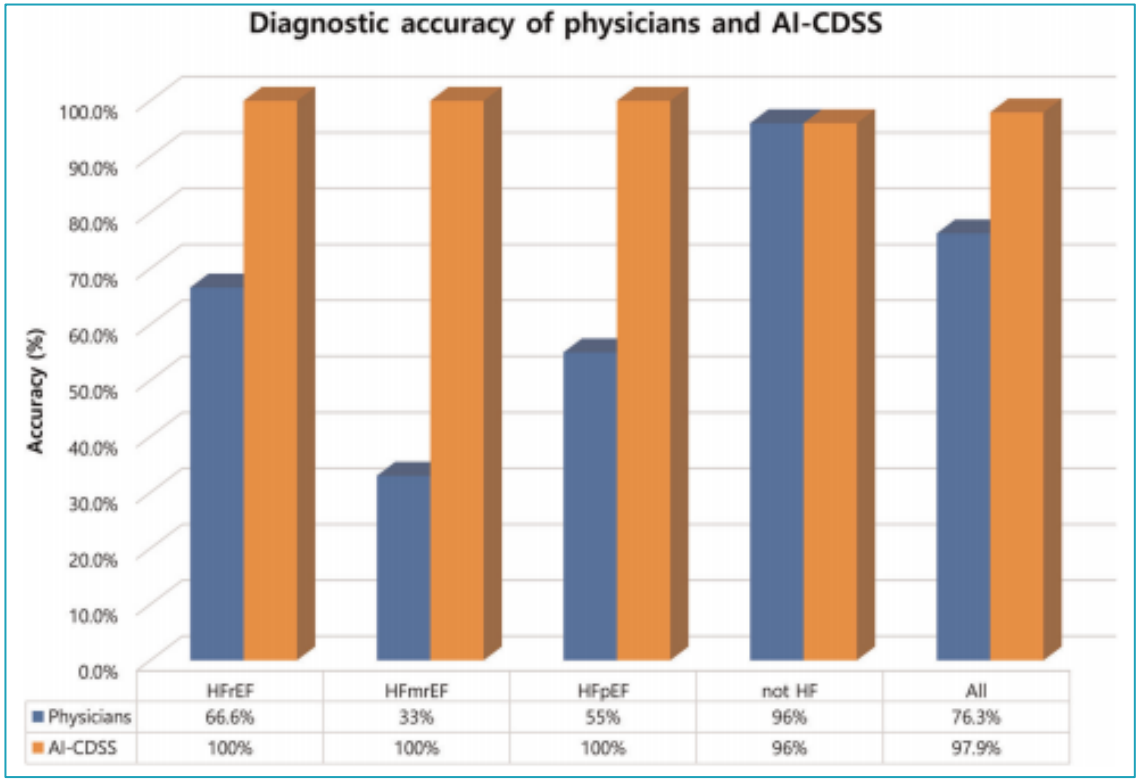


Pilot Study

연구계획서 제목	심부전 진단용 인공지능 플랫폼의 유용성에 대한 연구 (Clinical application of Artificial Intelligence Platform for the Diagnosis of Heart Failure)
연구목적	호흡곤란이 주소인 환자에서 심부전 진단에 대한 인공지능 플랫폼의 유용성 평가를 하고자 함.
연구 설계	A prospective, single arm, single-center, pilot study
연구 예상 기간	12 개월
연구대상자수	전체 100명
연구대상	호흡곤란 환자
시험 약	해당 사항 없음
용법 및 용량	해당 사항 없음
주요 선정기준	1. 만 19 세 이상, 80세 미만의 남•녀 2. 호흡곤란을 주소로 외래를 방문한 환자 3. 첫 번째 방문에서 심전도, NT-proBNP(or BNP) 및 심초음파를 시행한 환자 4. 본 임상연구에 참여할 것을 자발적으로 서면 동의한 자
주요 선정 제외 기준	1. 중증의 호흡곤란으로 입원치료가 필요한 환자 2. 의사소통이 어려운 환자
목표대상자수 산정	100명
유효성 평가 기준	**1. 일차 연구목표:** Diagnostic accuracy of clinical decision support system (CDSS) to diagnose heart failure. **2. 이차 연구목표** CDSS의 진단 정확도에 영향을 미치는 요소

Heart Failure Silo in IMP

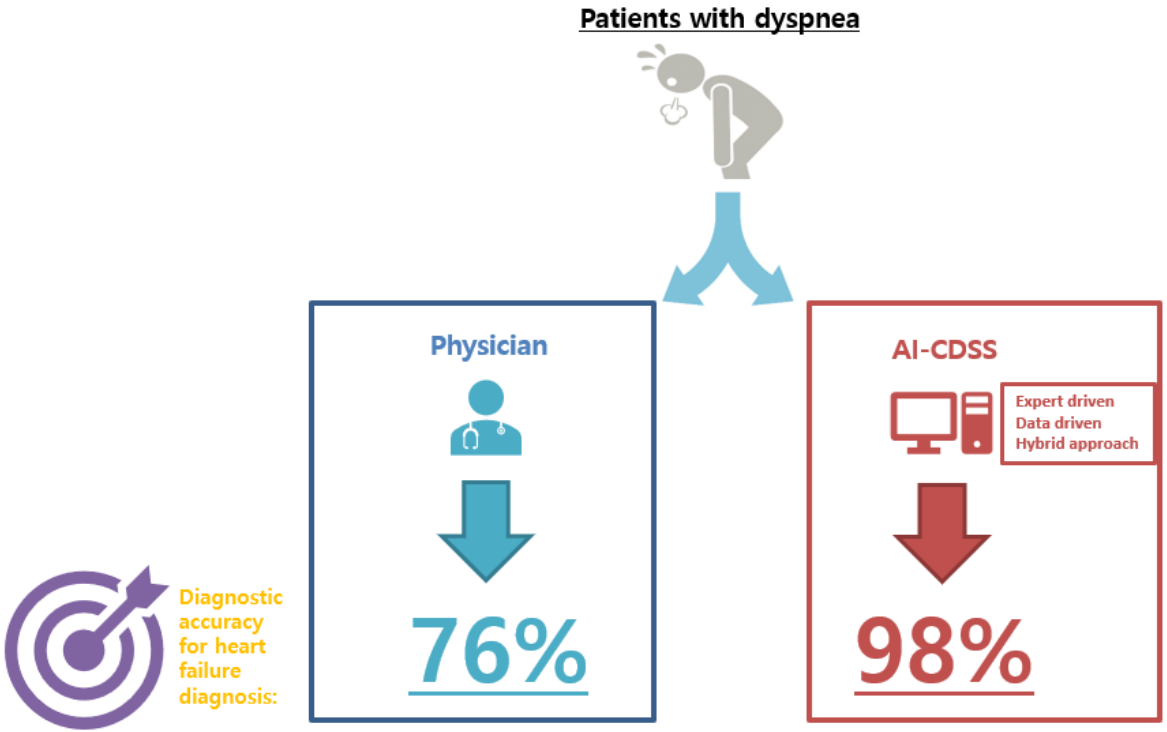
Physician vs AI-CDSS



	HFrEF	HFmrEF	HFpEF	not HF	All
Physicians	66.6%	33%	55%	96%	76.3%
AI-CDSS	100%	100%	100%	96%	97.9%

Heart Failure Silo in IMP

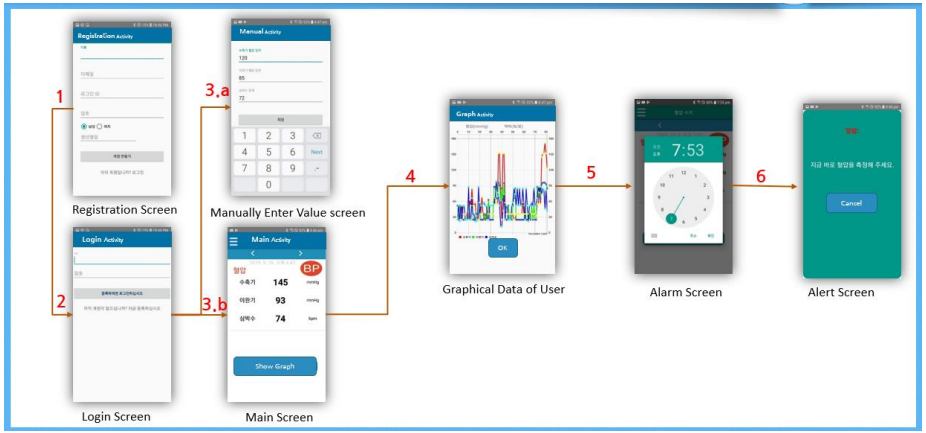
Physician vs AI-CDSS



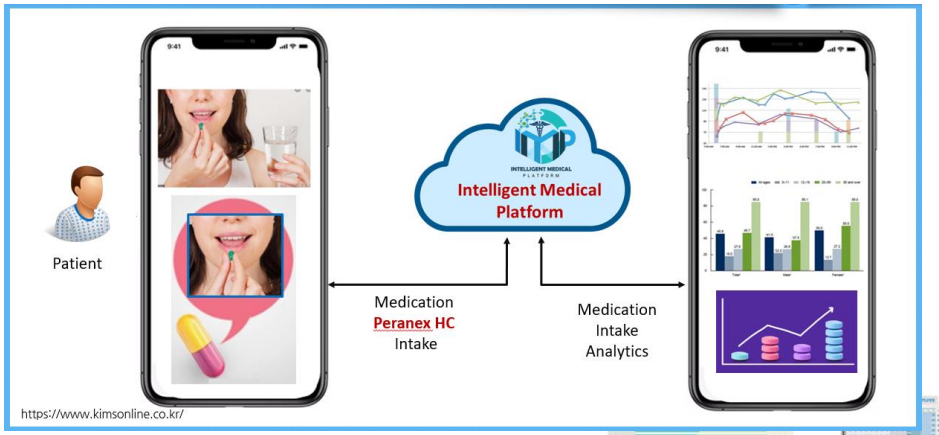
AI-CDSS in Home Care Setting

AI-Patient Monitoring and Management App.(AI-PAMM)

Monitoring



Management



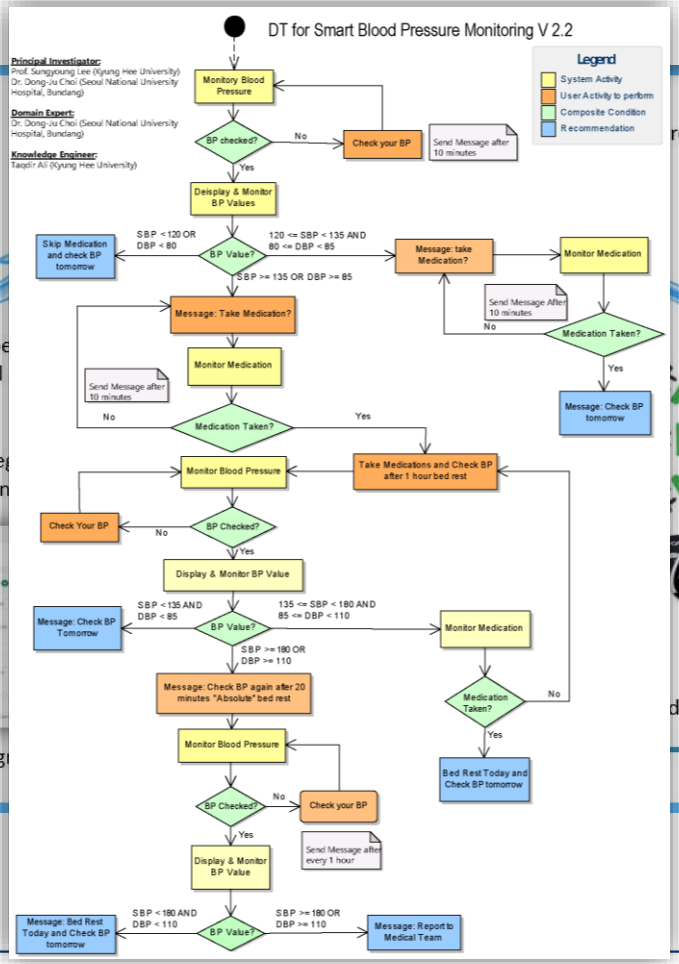
PAMM as CDSS

1

Physician develope
monitoring rules and

2 Inte
mon

Vital Sig



remotely

2 Hypertension monitoring API send information to server

API

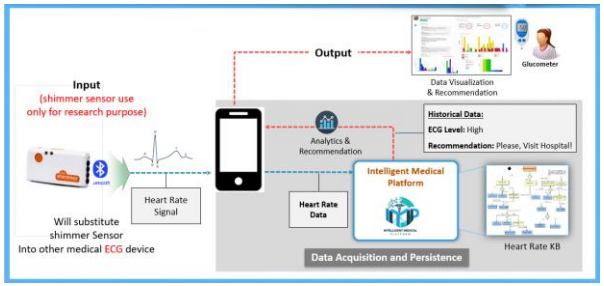
1 Patient Checking Blood Pressure

d suggestion to the patient

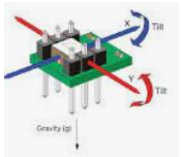
PAMM monitoring

Blood Pressure

ECG



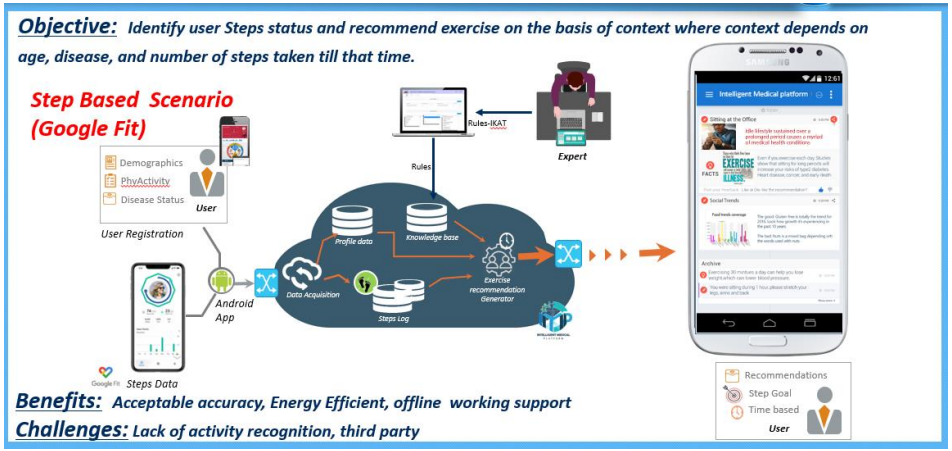
Behavior



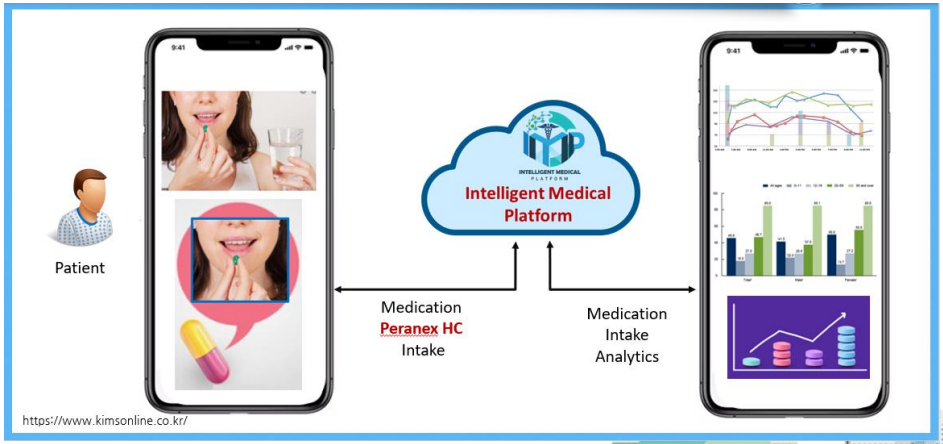
그 외의 접속 가능한 wearable devices…… PPG, Impedance, Bwt….

PAMM management

Behavior



Adherence



PAMM 임상연구

분당서울대학교병원 생명윤리심의위원회

Tel : 82-31-787-8801~8805
Fax : 82-31-787-8869

경기도 성남시 분당구 구미로 173번길 82 (우) 13620

HRPP SOP ver3.2_2018.06.01/e-IRB(rev) 2018.09.20

심의결과통보서

IRB No.	B-1904/532-301	제출경로	분당서울대학교병원
연구 과제명	(국문)	자가인식 앱 피드백 시스템을 통한 edoxaban 약물 순응도 향상 연구: 무작위대조군연구	
	(영문)	Self-awareness of drug adherence to edoxaban using an automatic app. feedback system: a randomized controlled study	
	Protocol No.	Adhere_App	Version No. 2.0

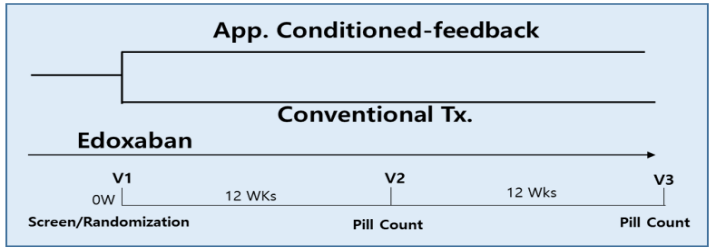
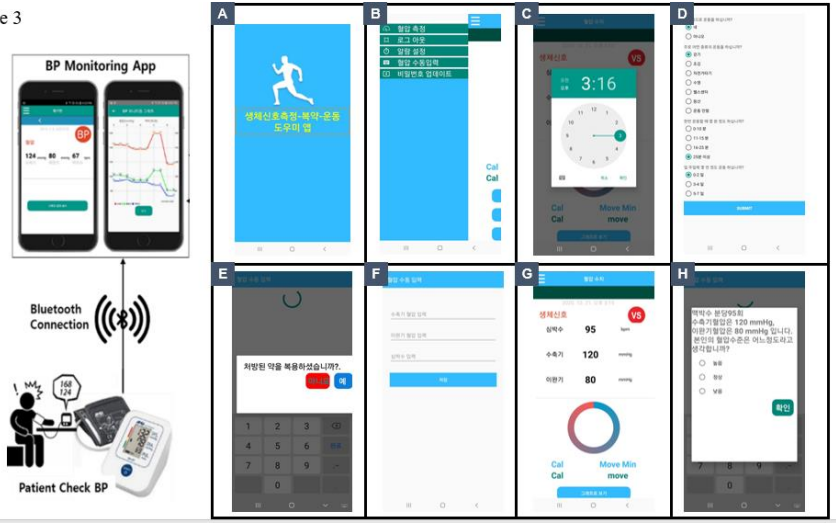
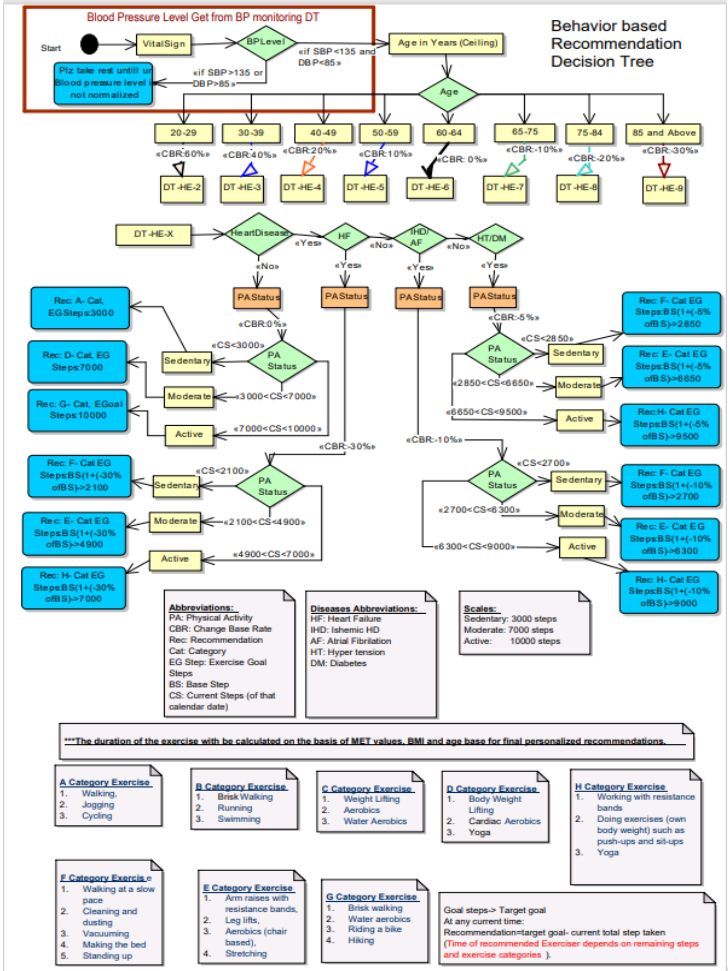


Figure 3



PAMM 임상연구


Blood Pressure Level Get from BP monitoring DT
Start
VitalSign
BPLevel
«if SBP<135 and DBP<85»
Plz take rest untill ur Blood pressure level not normalized
«if SBP>135 or DBP>85»
Age in Years (Ceiling)
Behavior based Recommendation Decision Tree
Age
20-29
30-39
40-49
50-59
60-64
65-75
75-84
85 and Above
«CBR:60%»
«CBR:40%»
«CBR:20%»
«CBR:10%»
«CBR: 0%»
«CBR:-10%»
«CBR:-20%»
«CBR:-30%»
DT-HE-2
DT-HE-3
DT-HE-4
DT-HE-5
DT-HE-6
DT-HE-7
DT-HE-8
DT-HE-9
DT-HE-X
HeartDisease
«Yes»
«No»
HF
IHD/ AF
HT/DM
PAStatus
«CBR:0%»
«CBR:-5%»
«CBR:-30%»
«CBR:-10%»
PA Status
Sedentary
Moderate
Active
«CS<3000»
«3000<CS<7000»
«7000<CS<10000»
«CS<2100»
«2100<CS<4900»
«4900<CS<7000»
«CS<2850»
«2850<CS<6650»
«6650<CS<9500»
«CS<2700»
«2700<CS<6300»
«6300<CS<9000»
Rec: A- Cat, EGSteps≤3000
Rec: D- Cat, EG Steps≤7000
Rec: G- Cat, EGoal Steps≥10000
Rec: F- Cat EG Steps:BS(1+(-30% ofBS)>2100
Rec: E- Cat EG Steps:BS(1+(-30% ofBS)>4900
Rec: H- Cat EG Steps:BS(1+(-30% ofBS)>7000
Rec: F- Cat EG Steps:BS(1+(-5% ofBS)>2850
Rec: E- Cat EG Steps:BS(1+(-5% ofBS)>6650
Rec:H- Cat EG Steps:BS(1+(-5% ofBS)>9500
Rec: F- Cat EG Steps:BS(1+(-10% ofBS)>2700
Rec: E- Cat EG Steps:BS(1+(-10% ofBS)>6300
Rec: H- Cat EG Steps:BS(1+(-10% ofBS)>9000
Abbreviations:
PA: Physical Activity
CBR: Change Base Rate
Rec: Recommendation
Cat: Category
EG Step: Exercise Goal Steps
BS: Base Step
CS: Current Steps (of that calendar date)
Diseases Abbreviations:
HF: Heart Failure
IHD: Ishemic HD
AF: Atrial Fibrillation
HT: Hyper tension
DM: Diabetes
Scales:
Sedentary: 3000 steps
Moderate: 7000 steps
Active: 10000 steps
***The duration of the exercise with be calculated on the basis of MET values, BMI and age base for final personalized recommendations.
A Category Exercise
1. Walking,
2. Jogging
3. Cycling
B Category Exercise
1. Brisk Walking
2. Running
3. Swimming
C Category Exercise
1. Weight Lifting
2. Aerobics
3. Water Aerobics
D Category Exercise
1. Body Weight Lifting
2. Cardiac Aerobics
3. Yoga
H Category Exercise
1. Working with resistance bands
2. Doing exercises (own body weight) such as push-ups and sit-ups
3. Yoga
F Category Exercis e
1. Walking at a slow pace
2. Cleaning and dusting
3. Vacuuming
4. Making the bed
5. Standing up
E Category Exercise
1. Arm raises with resistance bands,
2. Leg lifts,
3. Aerobics (chair based),
4. Stretching
G Category Exercise
1. Brisk walking
2. Water aerobics
3. Riding a bike
4. Hiking
Goal steps-> Target goal
At any current time:
Recommendation=target goal- current total step taken
(Time of recommended Exercise depends on remaining steps and exercise categories).

Rationale, Design, and Efficacy of a Smartphone Application for Improving Self-Awareness of Adherence to Edoxaban Treatment: A Randomized Controlled Study (Adhere App)

In-Cheol Kim[1], Ji-Hyun Lee[2], Dong-Ju Choi[2], Sung-Ji Park[3], Ju-Hee Lee[4], Sang Min Park[5], Mina Kim[6], Hack-Lyoung Kim[7], Sunki Lee[8], In-Jae Kim[9], Seounghoon Choi[10], Jaehun Bang[11], Bilal Ali[11], Musarrat Hussain[11], Taqdir Ali[11], and Sungyoung Lee[11]

BMJ Open - Manuscript ID bmjopen-2021-048777.R1 받은편지함 ×

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영어 › 한국어 메일 번역

COVID-19: A message from BMJ: https://authors.bmj.com/policies/covid-19

26-Jul-2021

Dear Dr. Kim:

Your manuscript entitled "Rationale, Design, and Efficacy of a Smartphone Application for Improving Self-Awareness of Adherence to Edoxaban Treatment: A Randomized Controlled Study (Adhere App)" being given full consideration for publication in BMJ Open.

Your manuscript ID is bmjopen-2021-048777.R1.

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Any individuals listed as co-authors on this manuscript are copied into this submission confirmation email. If you believe that you have received this email in error, please contact the Editorial Office.

CDSS(Clinical Decision Supporting System)

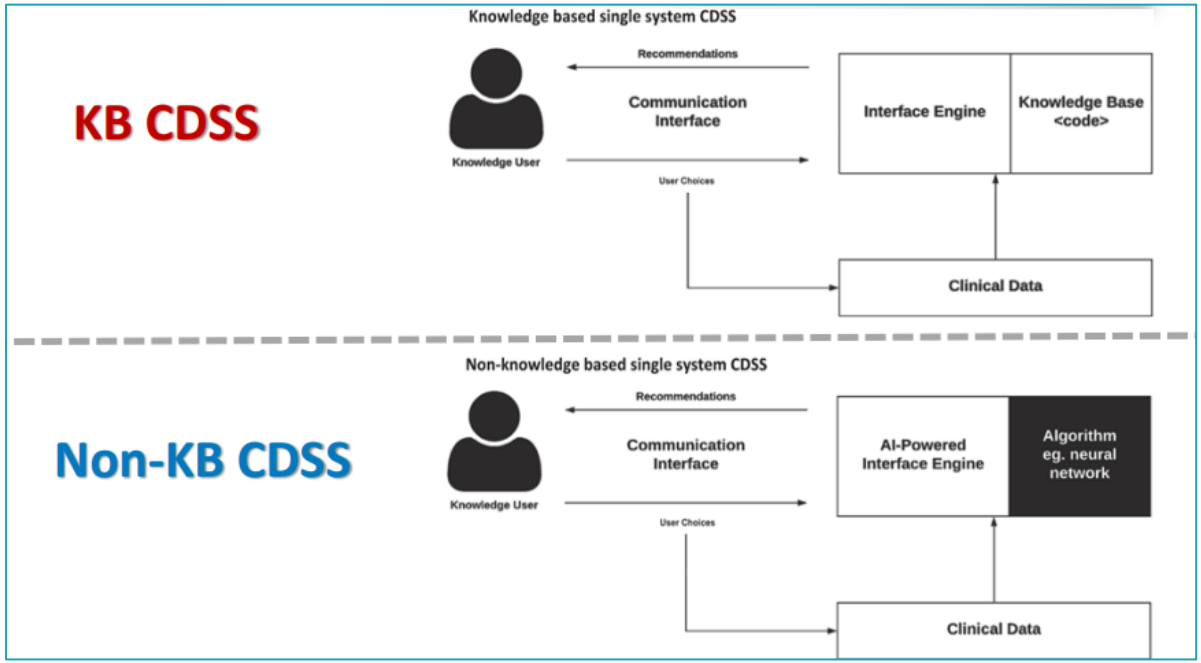


Image Based CDSS

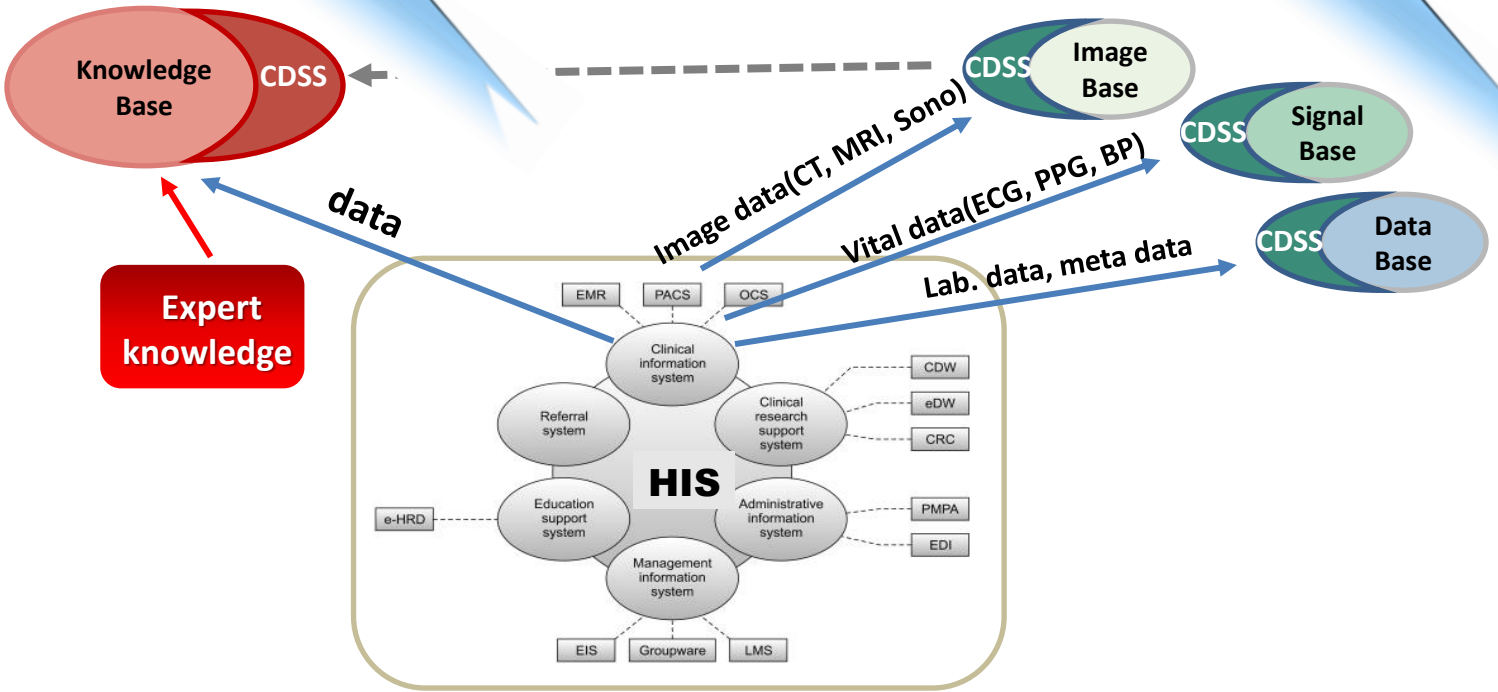
Signal Based CDSS

Data Based CDSS

CDSS's

Diagnosis
Management
Risk Prediction

Diagnosis
(lung ca, pneumonia, arrhythmia, MI..)



Massages

1. AI-CDSS may be useful for the diagnosis of HF, especially when HF specialists are not available in hospital setting.
2. AI-CDSS may be also useful for the monitoring and managements of chronic disease in usual life setting.
3. It is necessary to devise ways in which many kinds of AI-CDSS and SaMD can be used complementary to or fused with each other.
4. Methods that can smoothly link HIS and CDSS is essential.