



AI AND CKD

OIKONOMAKI THEODORA

NEPHROLOGIST

EVAGGELISMOS GENERAL HOSPITAL OF ATHENS

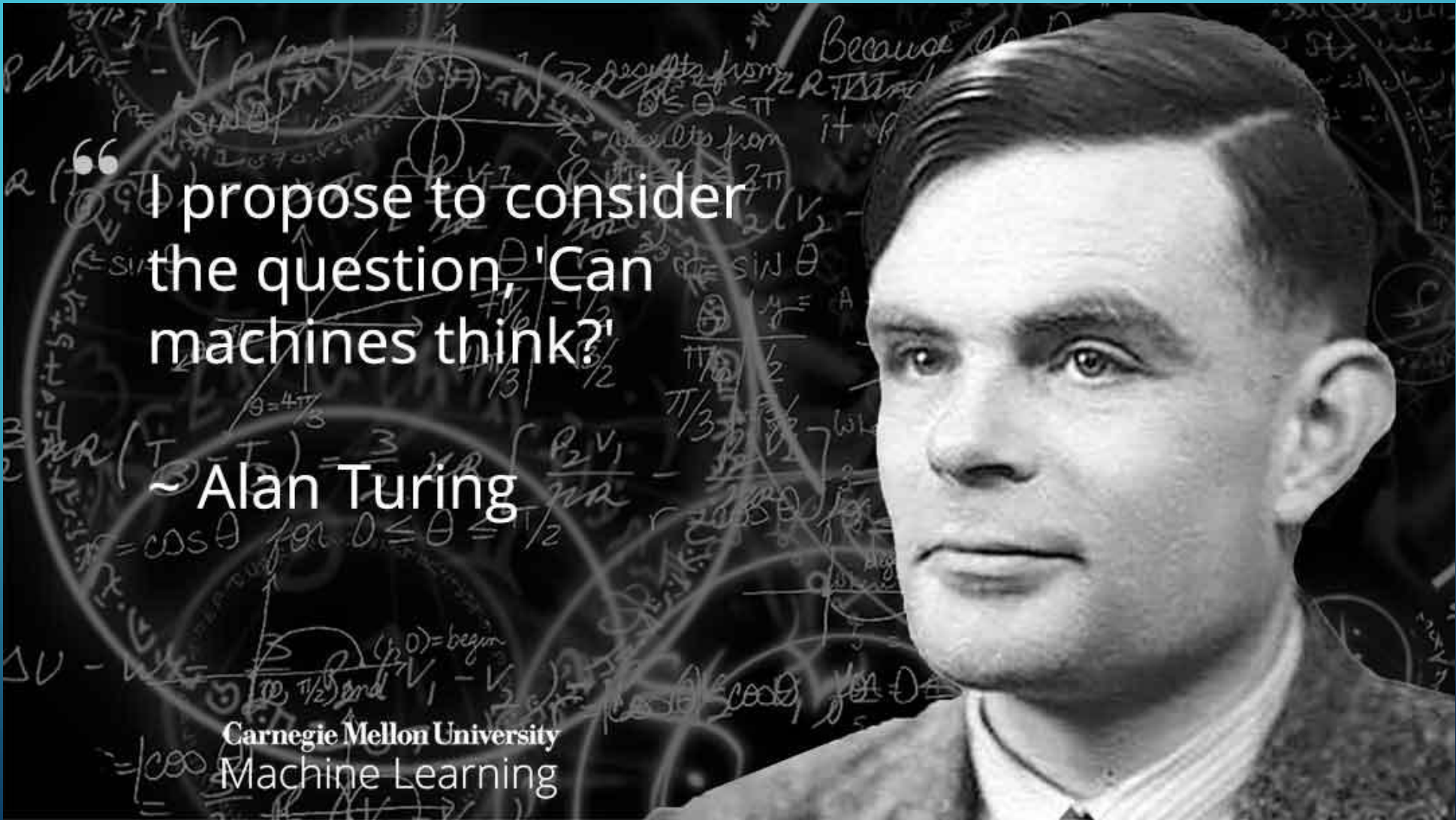


ARTIFICIAL INTELLIGENCE

ARTIFICIAL INTELLIGENCE

It is a branch of computer science that deals with the design, development, and implementation of 'smart' systems that can perform activities imitating human intelligence.

* Intelligence: the set of mental functions we use to address new situations and solve problems by leveraging prior experiences.



“ I propose to consider the question, 'Can machines think?'

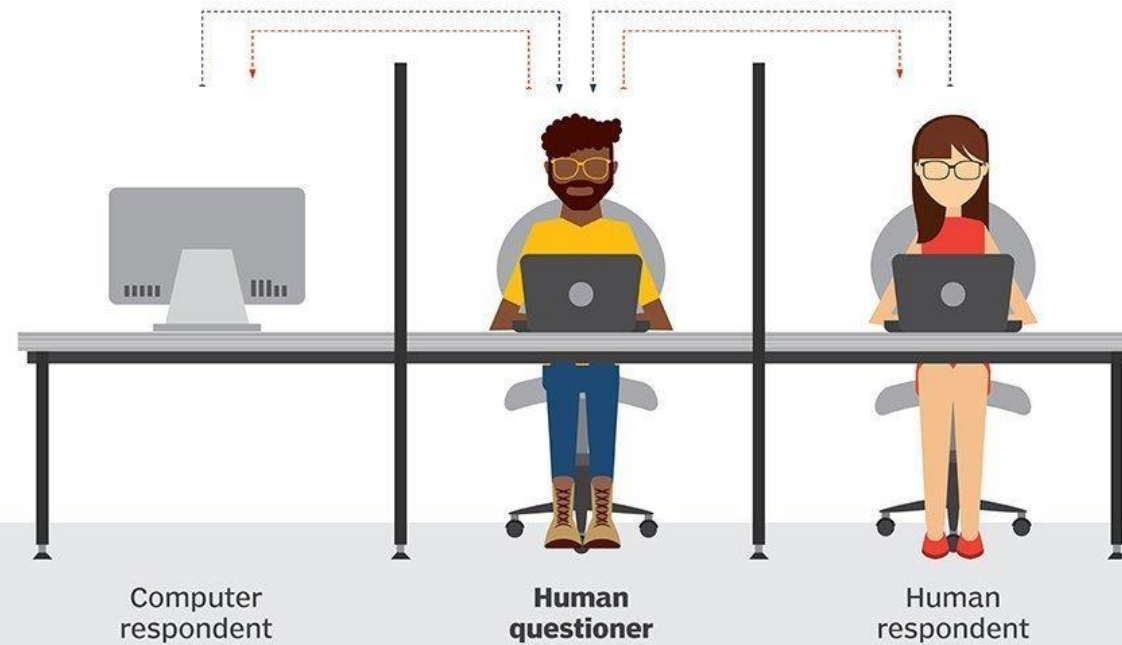
~ Alan Turing

Carnegie Mellon University
Machine Learning

Turing test

During the Turing test, the human questioner asks a series of questions to both respondents. After the specified time, the questioner tries to decide which terminal is operated by the human respondent and which terminal is operated by the computer.

■ QUESTION TO RESPONDENTS ■ ANSWERS TO QUESTIONER



TECHNOLOGY

Google's AI passed a famous test – and showed how the test is broken

The Turing test has long been a benchmark for machine intelligence. But what it really measures is deception.

THE TURING DECEPTION

David Noever, Matt Ciolino

PeopleTec, Inc., Huntsville, Alabama, USA

david.noever@peopletec.com



i'm not a robot



CAPTCHA
Privacy - Terms

Eps10 vecTor

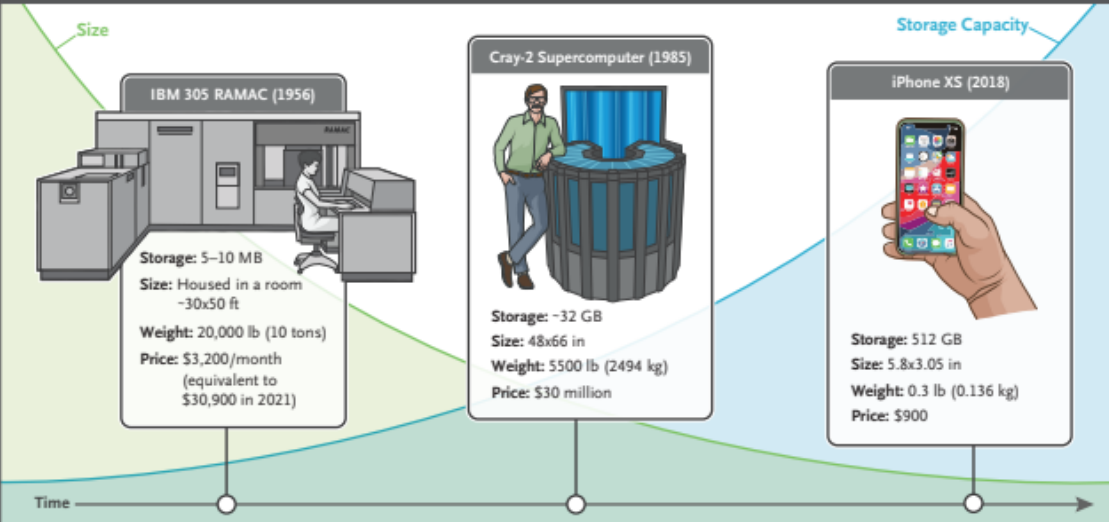
Type the two words:

Eps10 vecTor

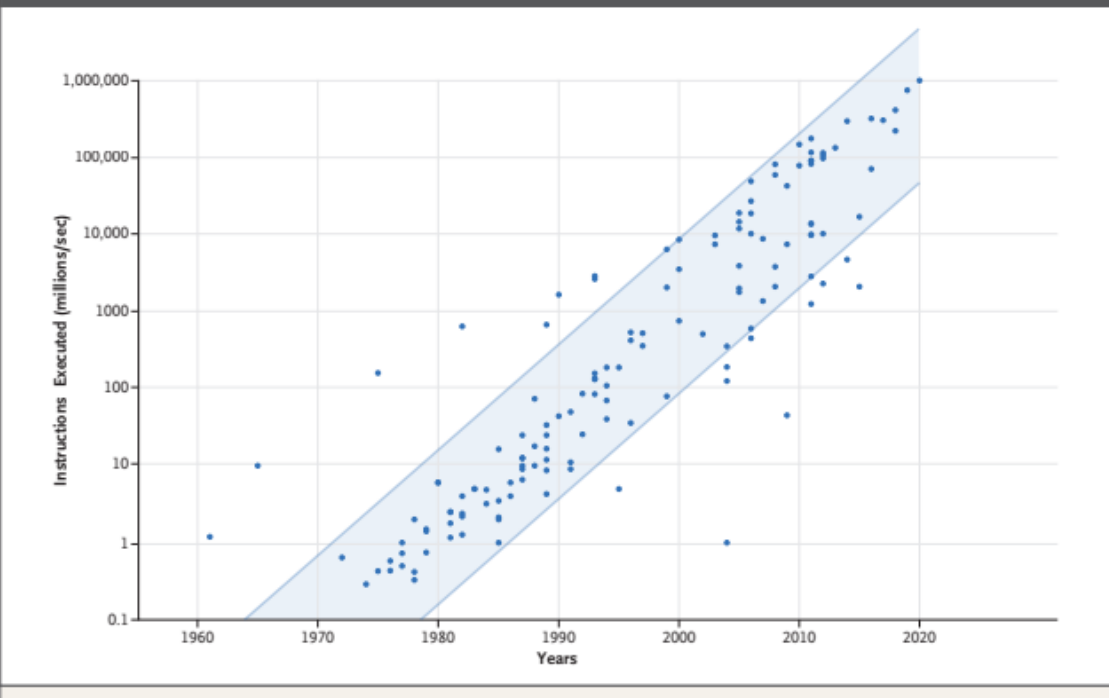


CAPTCHA
Privacy - Terms

A Advances in Storage Capacity



B Advances in Speed



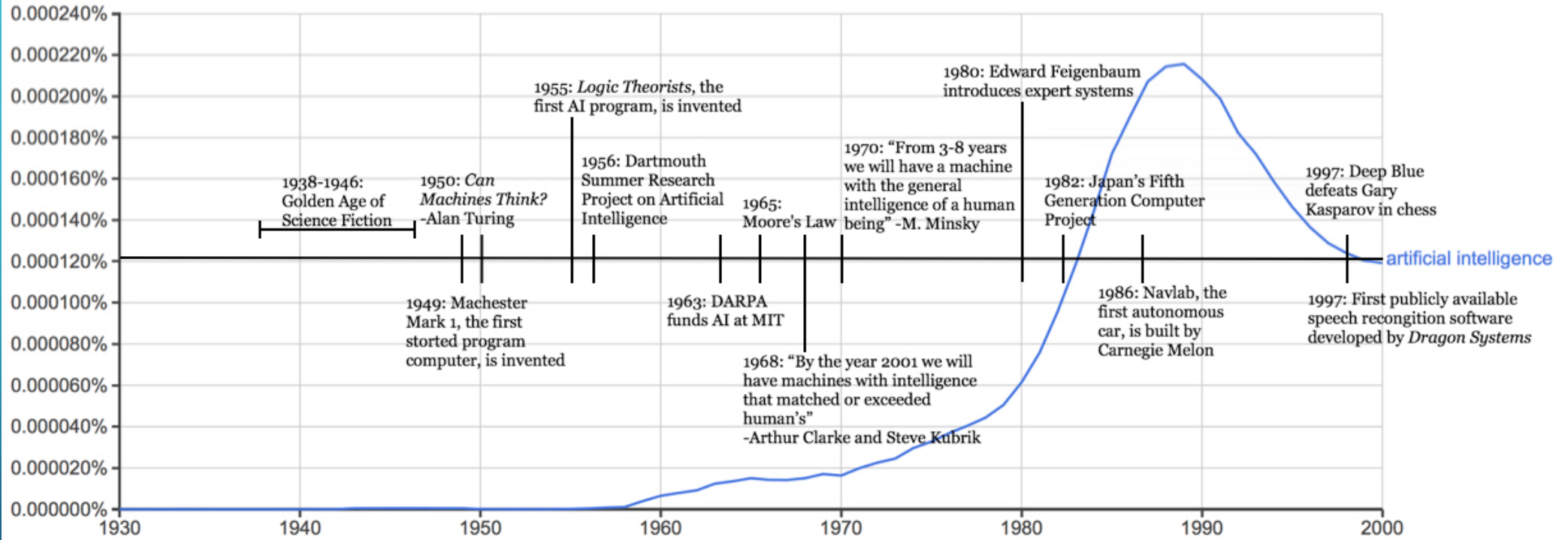
↑ Storage Capacity

↑ Processing Speed

↓ Device Volume

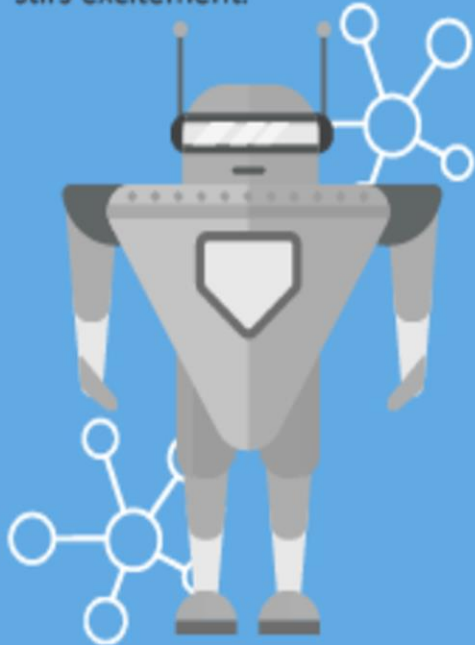
↓ Cost

ARTIFICIAL INTELLIGENCE TIMELINE



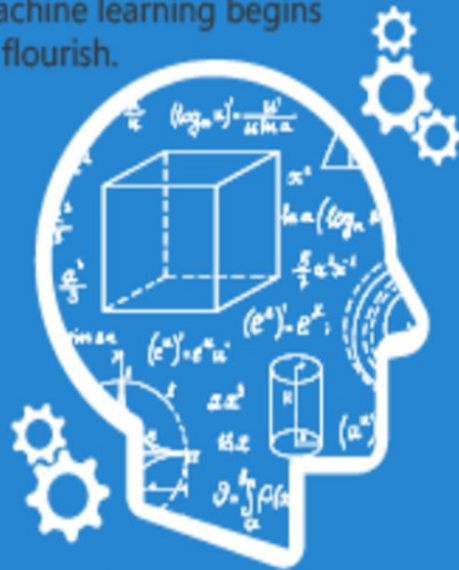
ARTIFICIAL INTELLIGENCE

Early artificial intelligence stirs excitement.



MACHINE LEARNING

Machine learning begins to flourish.



DEEP LEARNING

Deep learning breakthroughs drive AI boom.

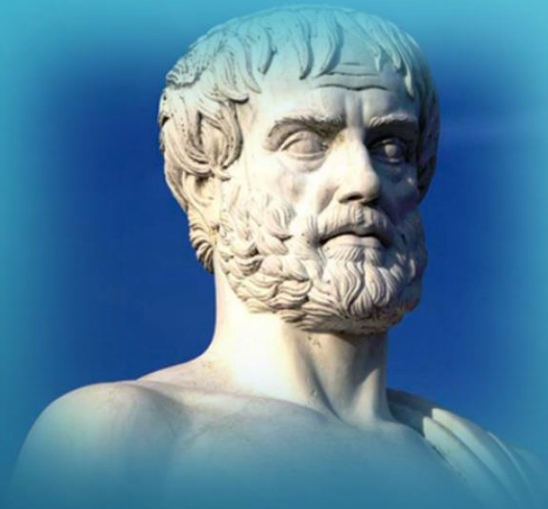


MACHINE LEARNING

Advanced data analysis and computation technique that leverages exceptional processing speed and pattern recognition techniques on the data fed to or accessed by computers to extract knowledge.

Pattern recognition leads to the identification of recurring patterns or trends.

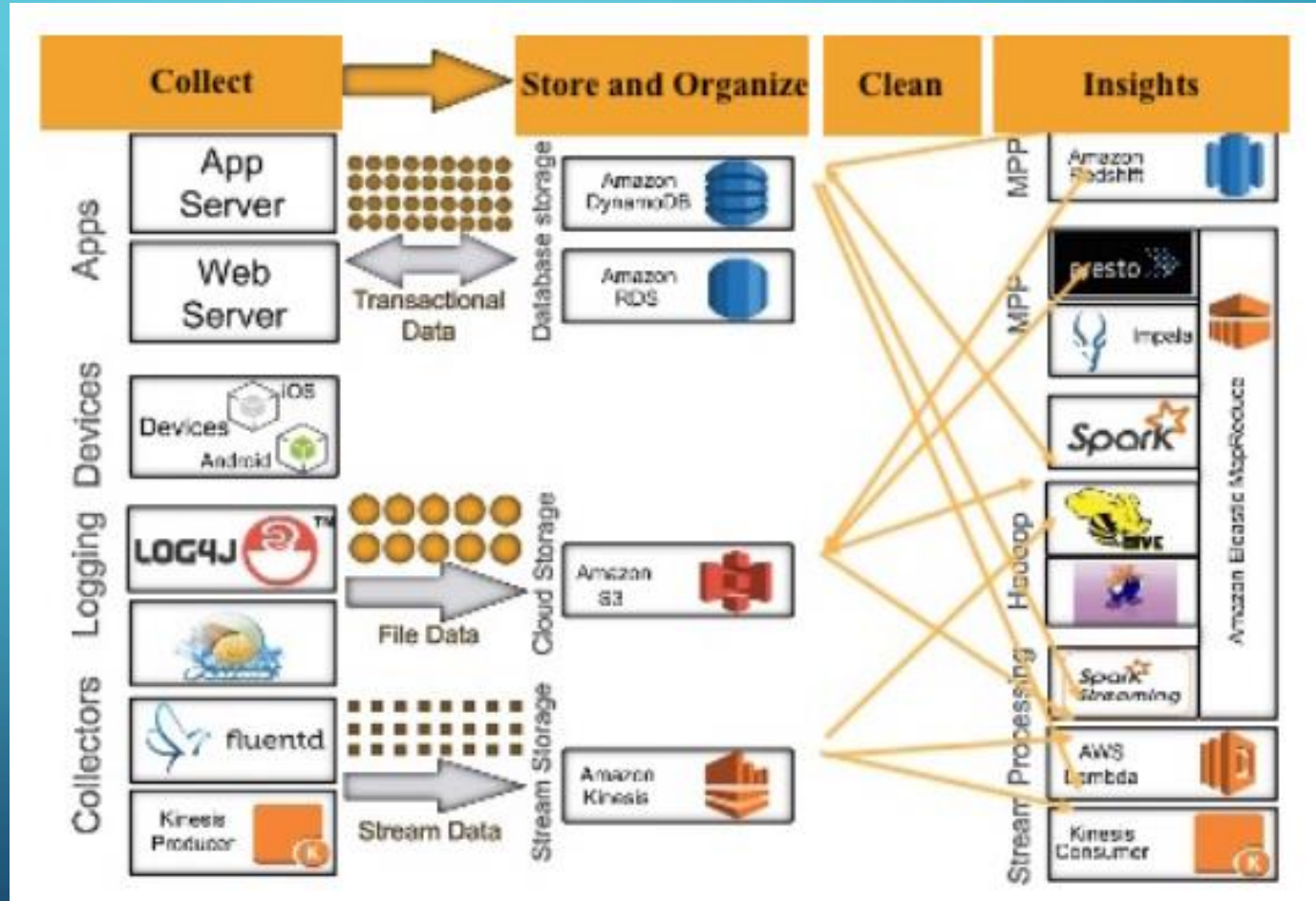
MACHINE LEARNING



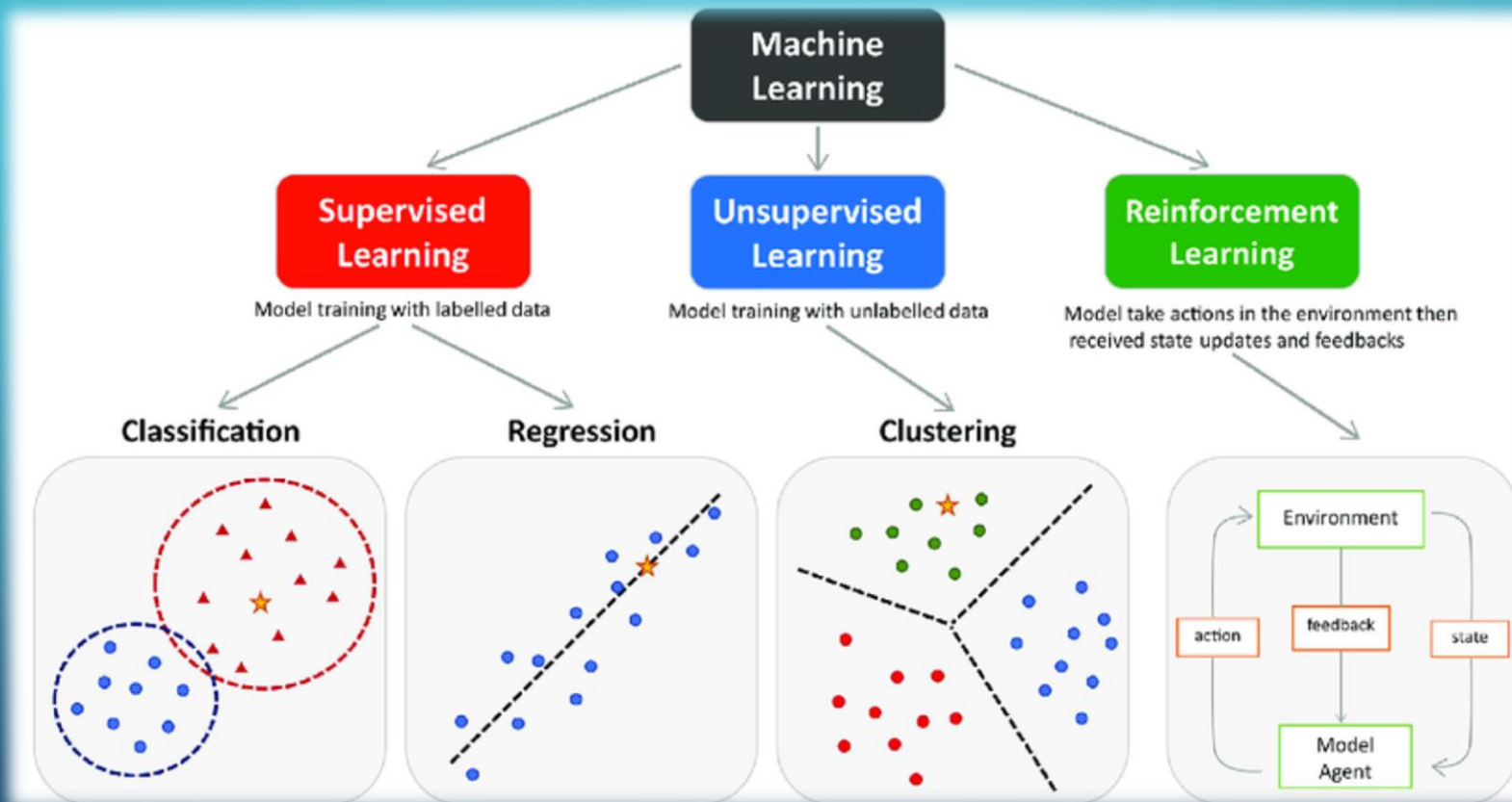
Aristotle
(384 - 322 b.C.)

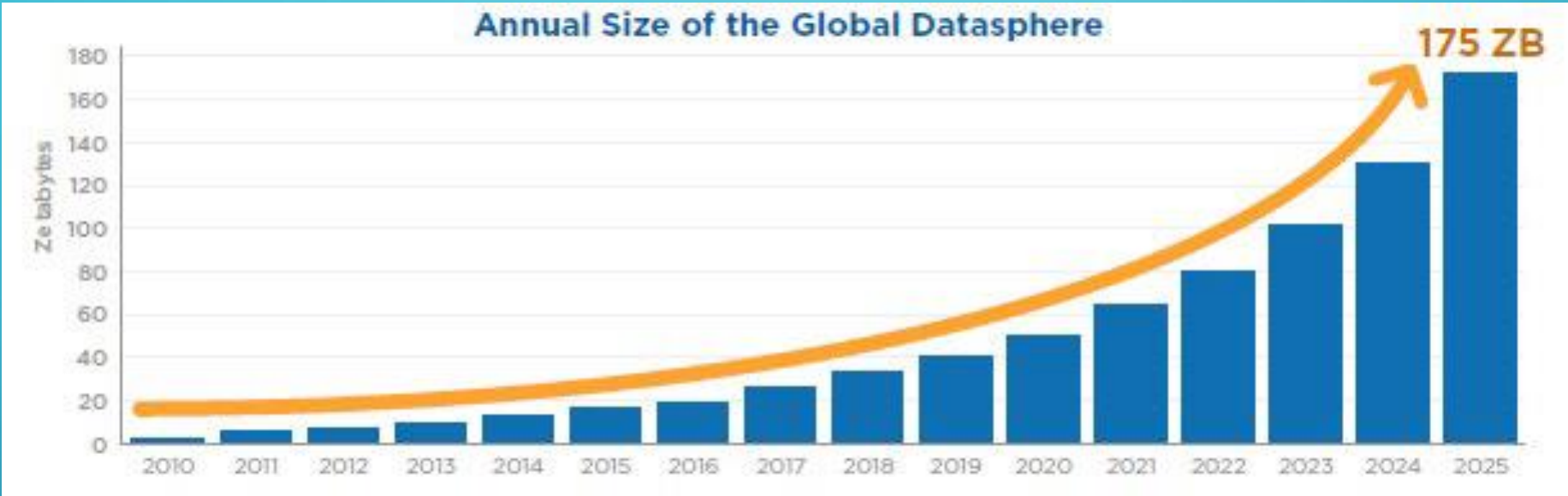
Reasoning is a sequence of thoughts that comes into play when a question is posed. With the emergence of this particular question, a certain thought follows, which is a consequence of the truth of the matter.

MACHINE LEARNING: CLUSTERING



MACHINE LEARNING





COMPUTATIONAL
POWER



DEEP
LEARNING

DEEP LEARNING

From large-scale data:

- Development of useful applications
- Customization of applications for personalized use, according to the needs of each user.

❖ ARTIFICIAL NEURAL NETWORKS

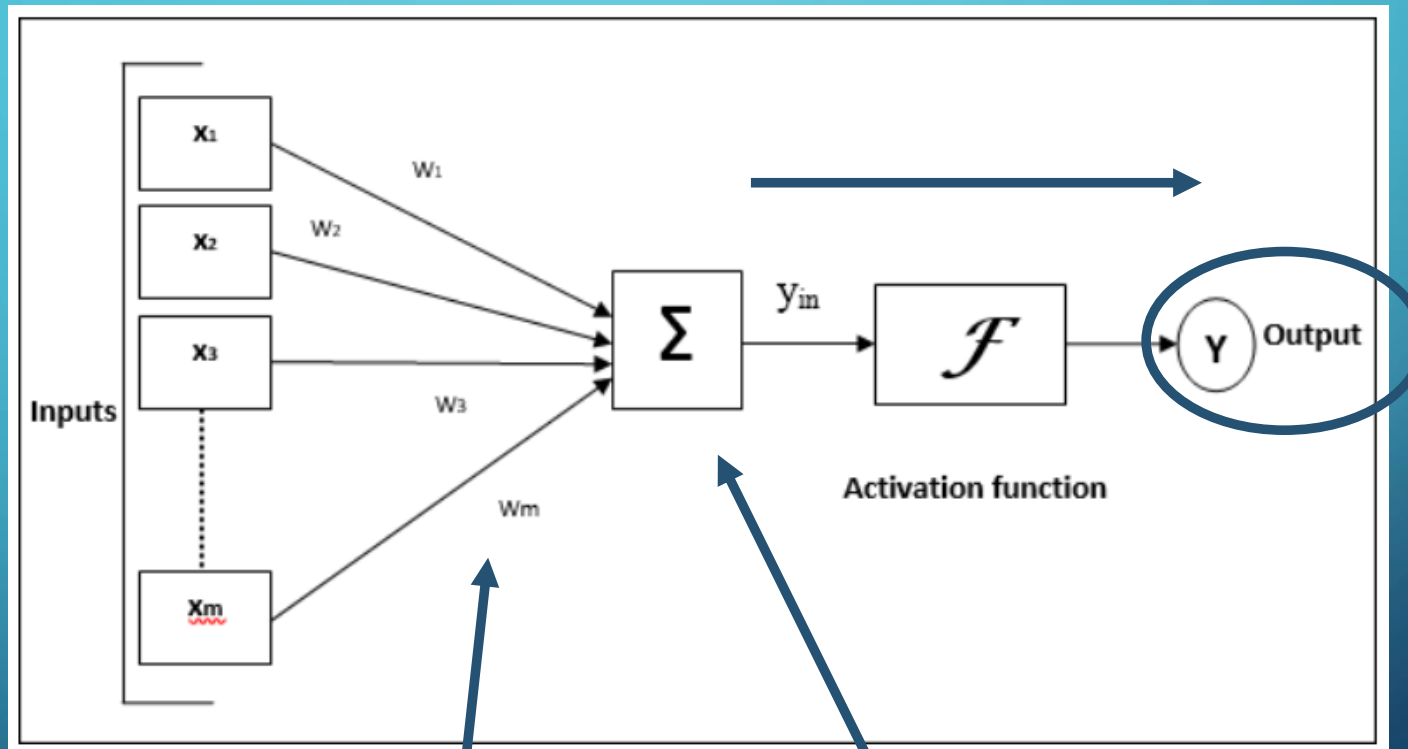
ARTIFICIAL NEURAL NETWORKS

= an array of artificial neurons

They are interconnected neural computing elements

They respond to stimuli they receive at their input and learn to adapt to their environment, using specific algorithms.

MODEL OF THE ARTIFICIAL NEURON



WEIGHTS

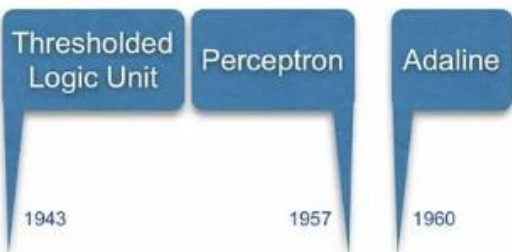
ADDER

ARTIFICIAL NEURAL NETWORKS

They are multiple units interconnected with:

- Adaptability
- Generalizability
- Temporally evolving – "Training Algorithm"

Beginnings



1940

1950

1960



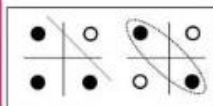
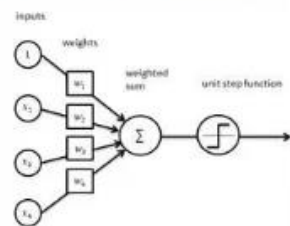
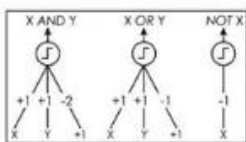
S. McCulloch - W. Pitts



R. Rosenblatt



B. Widrow - M. Hoff



1st Neural Winter

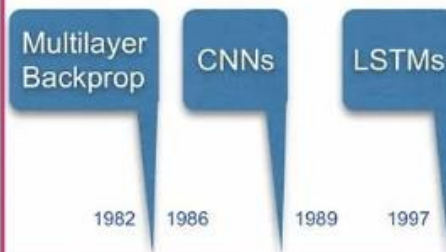


1970



M. Minsky - S. Papert

2nd Neural Winter



1980

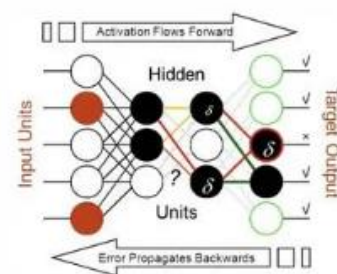
1990



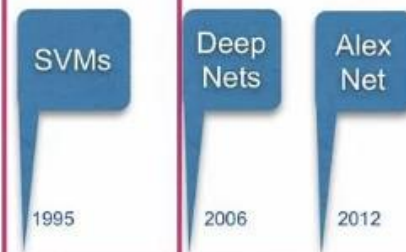
P. Werbos

D. Rumelhart - G. Hinton - R. Williams

Y. Lecun - J. Schmidhuber



GPU Era



2000

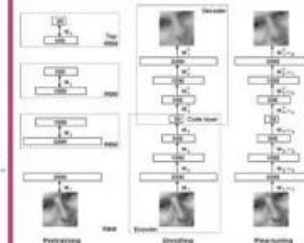
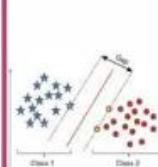
2010



C. Cortes - V. Vapnik



R. Salakhutdinov - J. Hinton - A. Krizhevsky - I. Sutskever



Who Is Investing in AI?

Number of artificial intelligence investments by investor, worldwide as of May 2019



@StatistaCharts Source: index.co

statista

CKD

Epidemiology of chronic kidney disease: an update 2022

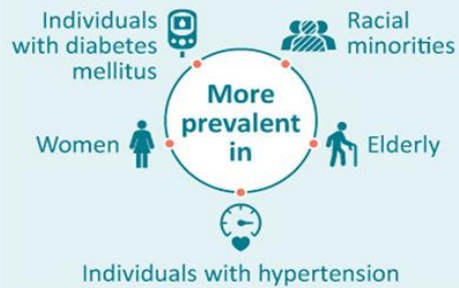
kidney
INTERNATIONAL
supplements



Extremely common

843,6 Million
in 2017

Approximately **1 in 10**



Increasing death rate

+41.5% 1990 to 2017



Rank in cause of death

Large burden in
low- and middle-income countries



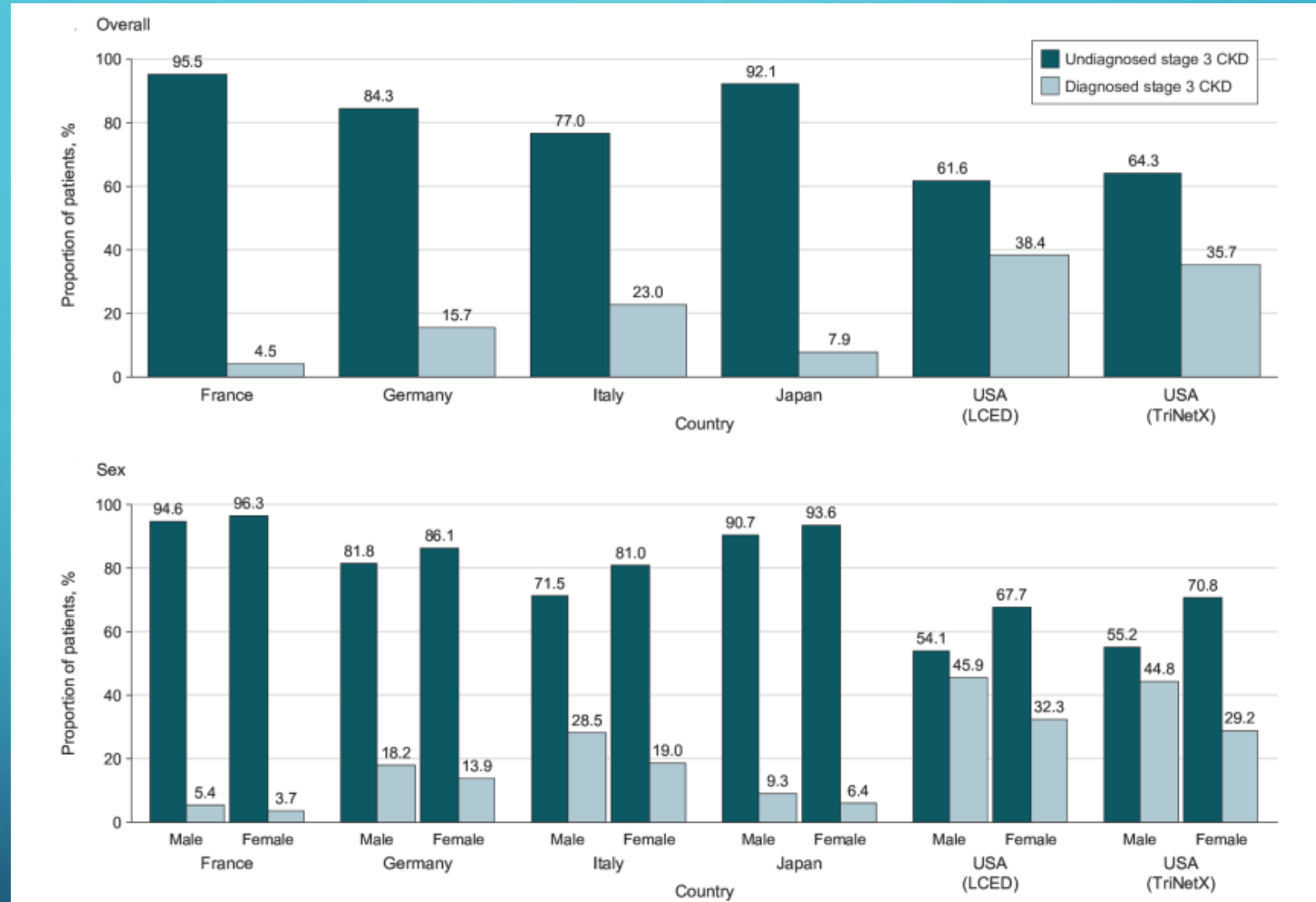
Among the **top 10 causes** of death
in Singapore, Greece, and Israel

Kovesdy, 2022

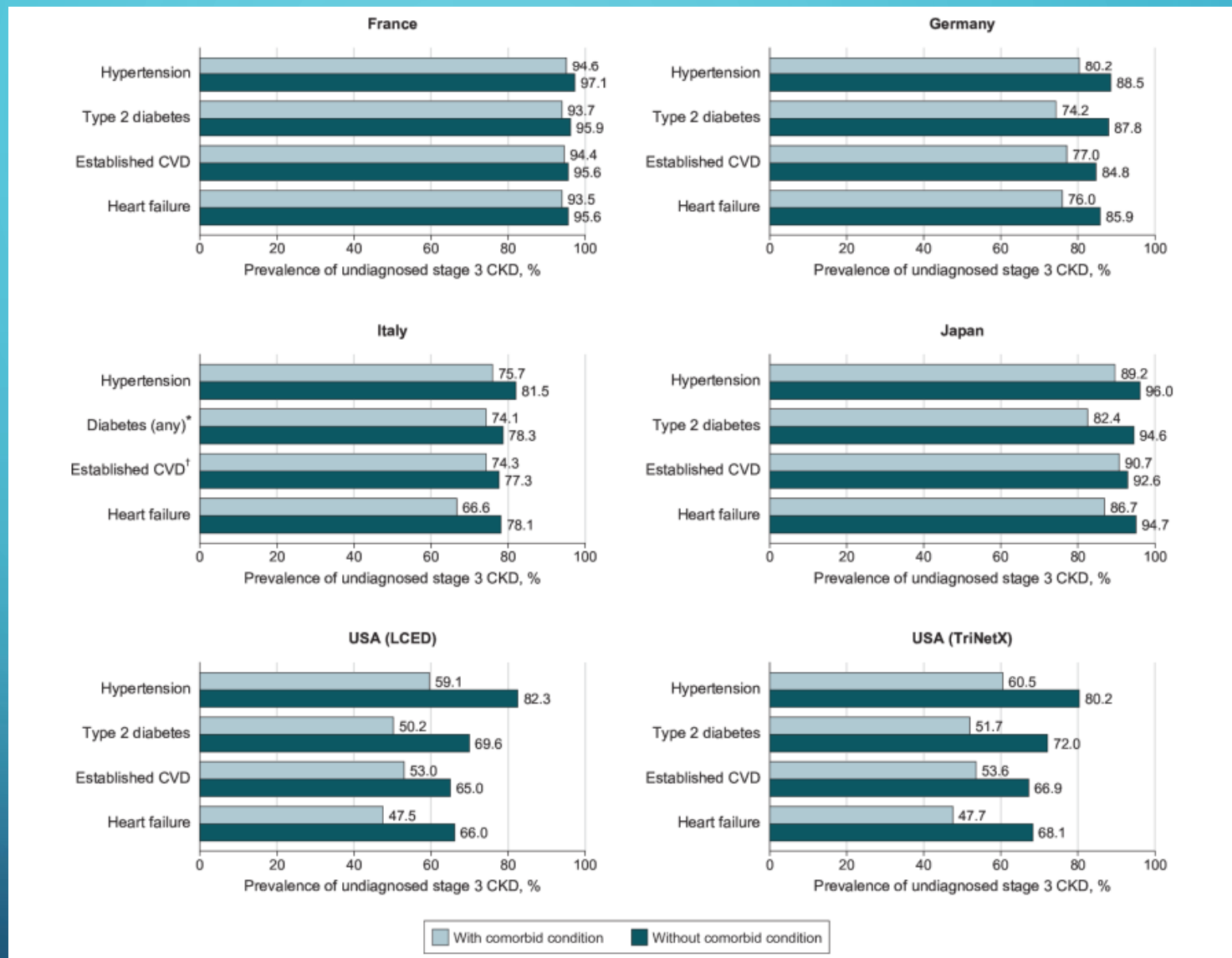
CONCLUSION

Chronic kidney disease (CKD) occurs frequently and has devastating consequences. This should prompt major efforts to develop preventative and therapeutic measures that are effective. The aim of these measures should be lowering the incidence of CKD and slowing its progression.

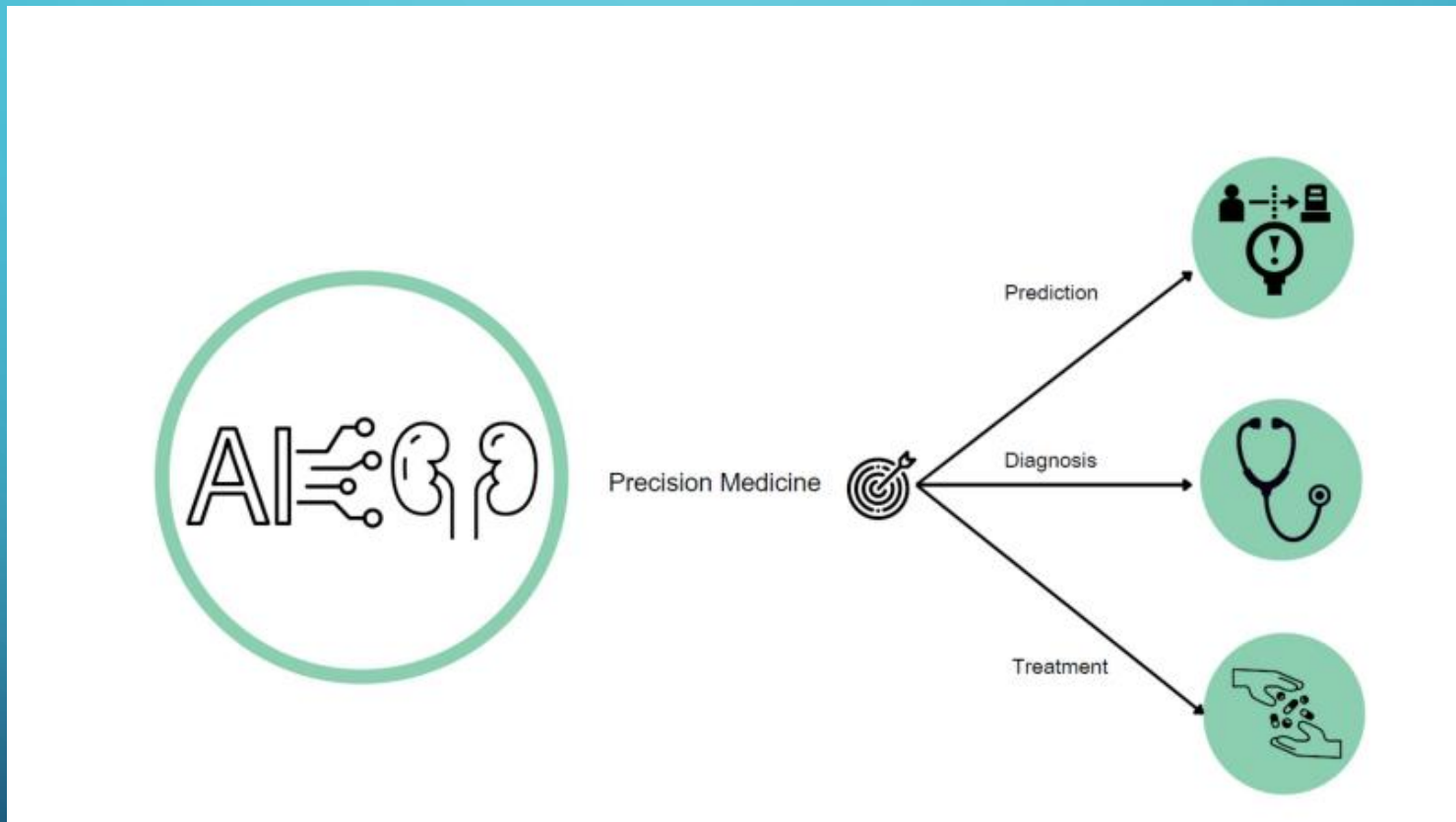
CKD



CKD

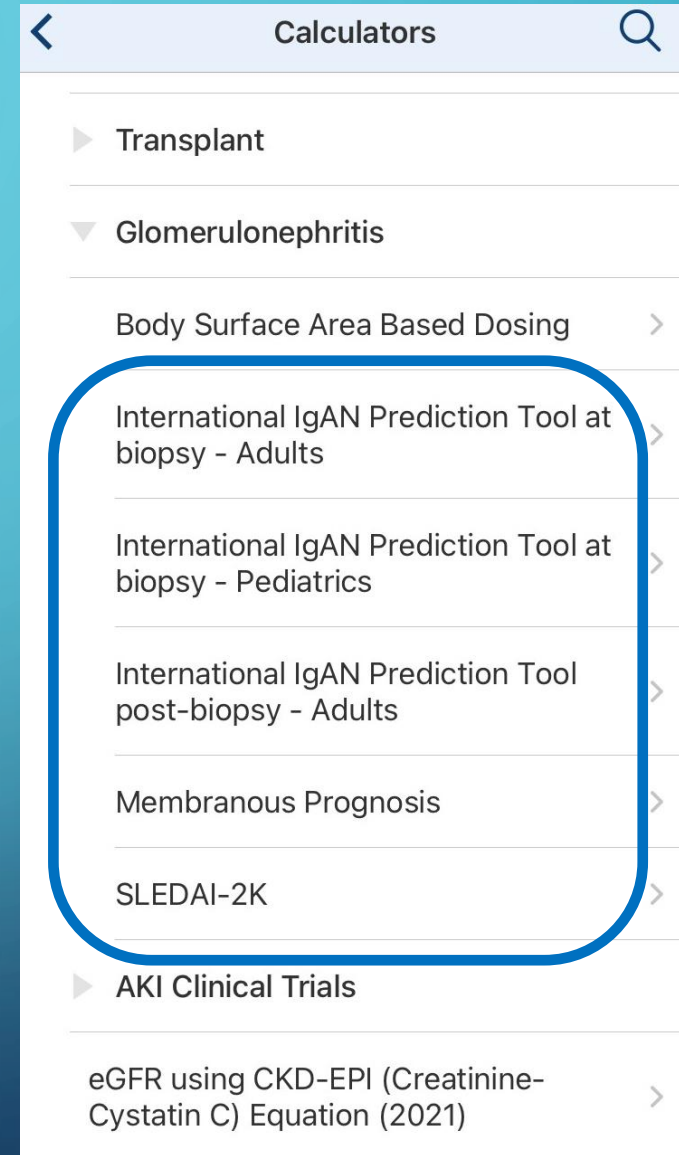
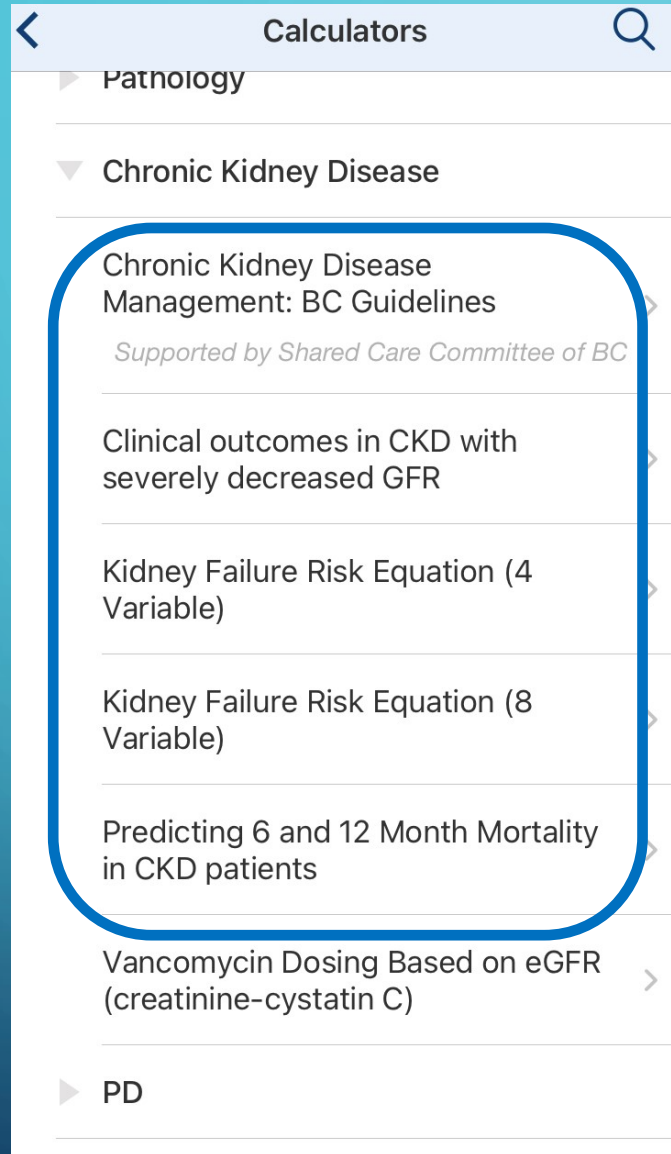


AI AND CKD

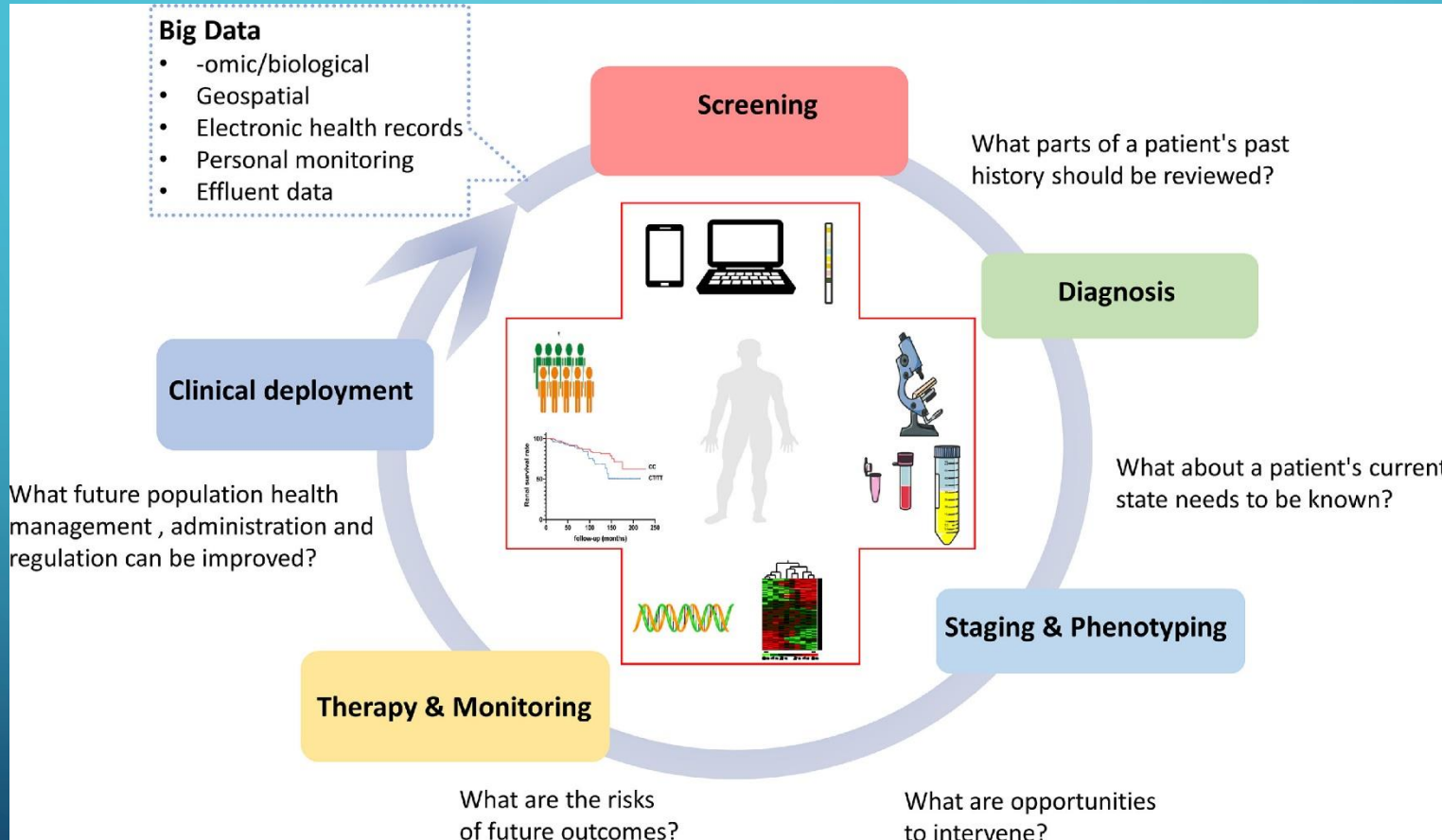


AI AND CKD: PREDICTION

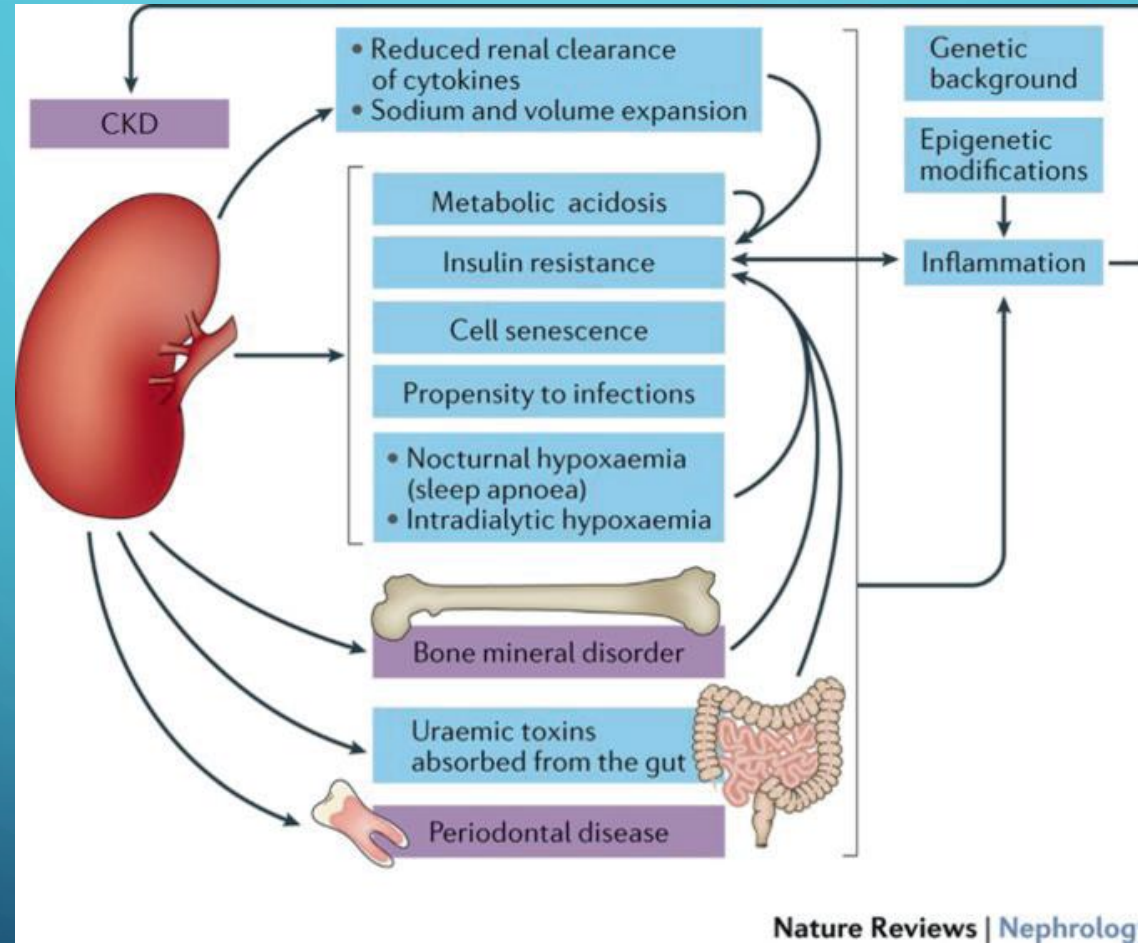
- What is the risk of someone developing ESRD (End-Stage Renal Disease)? (XGBoost ecc)
- Assessment of the progression of specific kidney diseases using prediction models (scores). (IgAN- tool, IBOX ecc)
- Application of personalized models in pediatric patients with kidney involvement. (STARZ score)



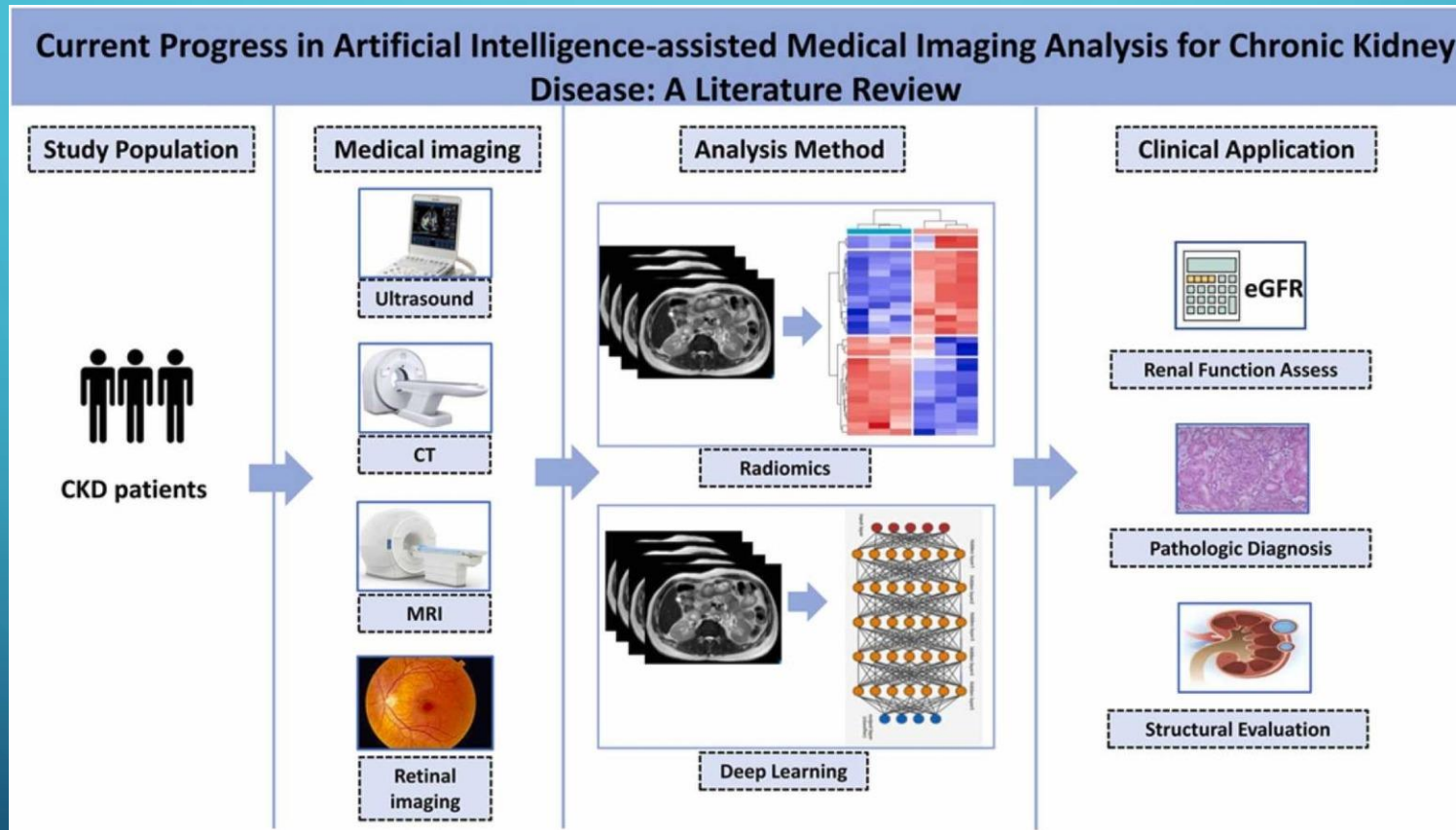
AI AND CKD: DIAGNOSIS



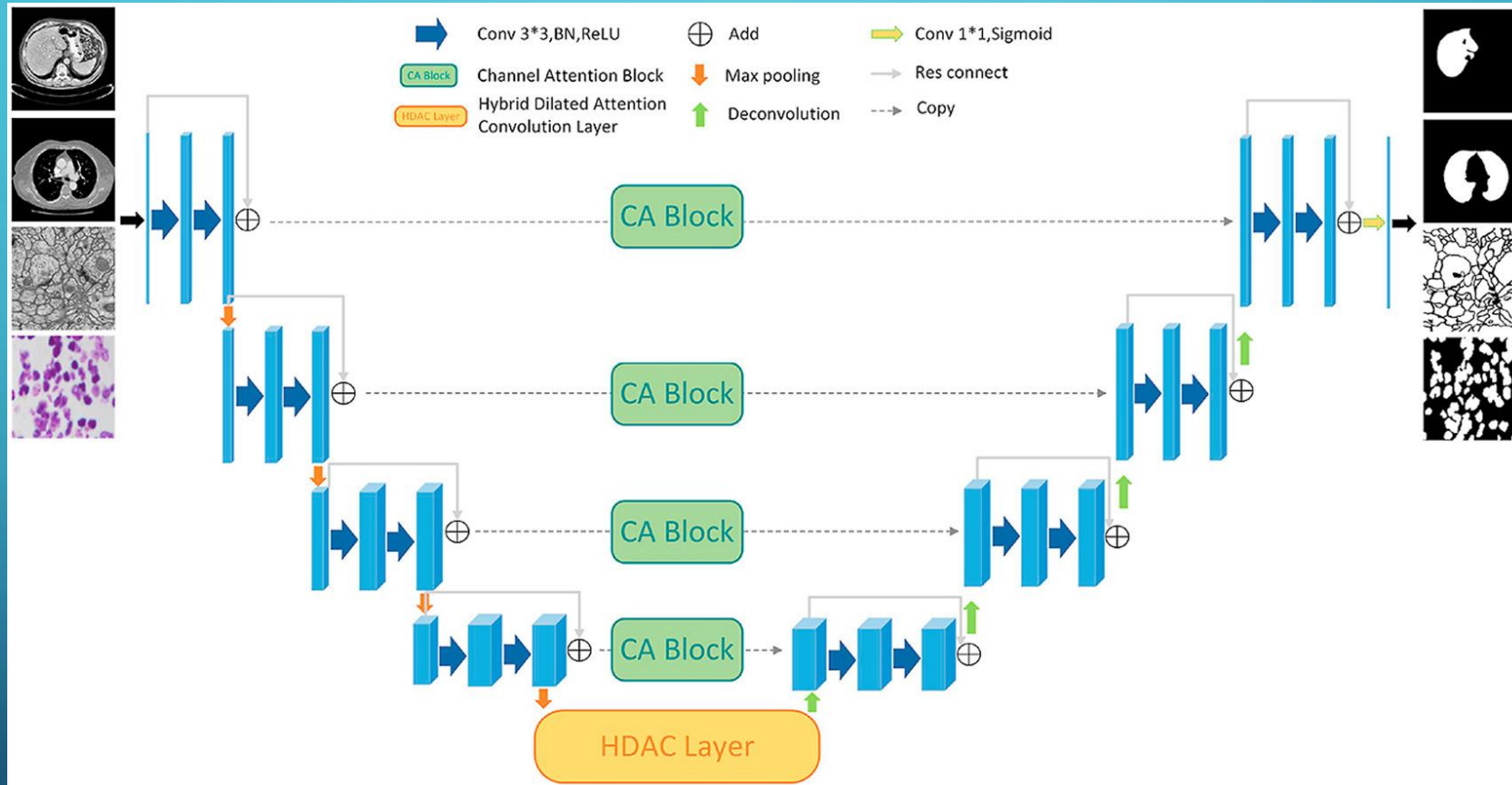
AI AND CKD: DIAGNOSIS



AI AND CKD: DIAGNOSIS



AI AND CKD: DIAGNOSIS



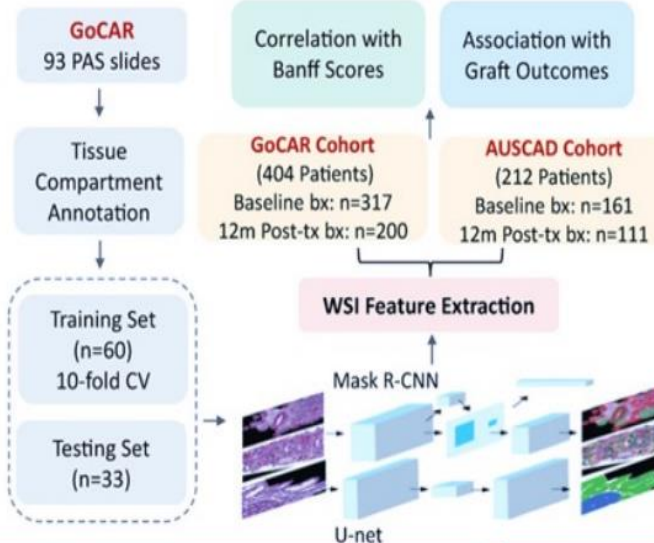
Zekun Wang, Yanni Zou, Peter X. Liu,
Hybrid dilation and attention residual U-Net for medical image segmentation,
Computers in Biology and Medicine, 2021

AI AND CKD: DIAGNOSIS

Deep learning identified pathological abnormalities predictive of graft loss in kidney transplant biopsies.

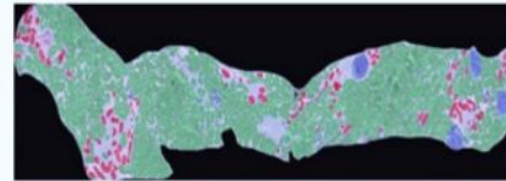


Methods and Cohorts

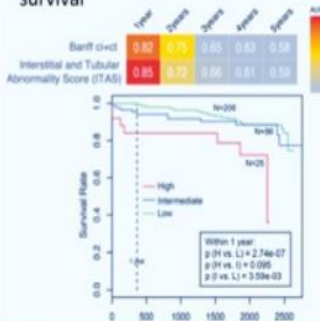


Findings

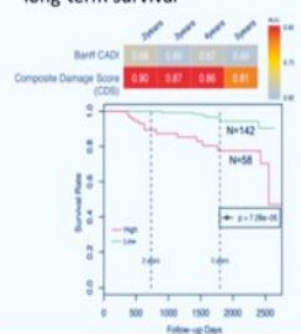
WSI Prediction



Baseline feature ITAS predicts 1-year survival



12m post-tx feature CDS predicts long-term survival



Yi, 2021

CONCLUSION

This deep-learning approach accurately detected and quantified pathological lesions from baseline or post-transplant biopsies, and demonstrated superior ability for prediction of post-transplant graft loss with potential application as a prevention, risk stratification or monitoring tool.

AI AND CKD: DIAGNOSIS

Use of Natural Language Processing to extract data from medical records

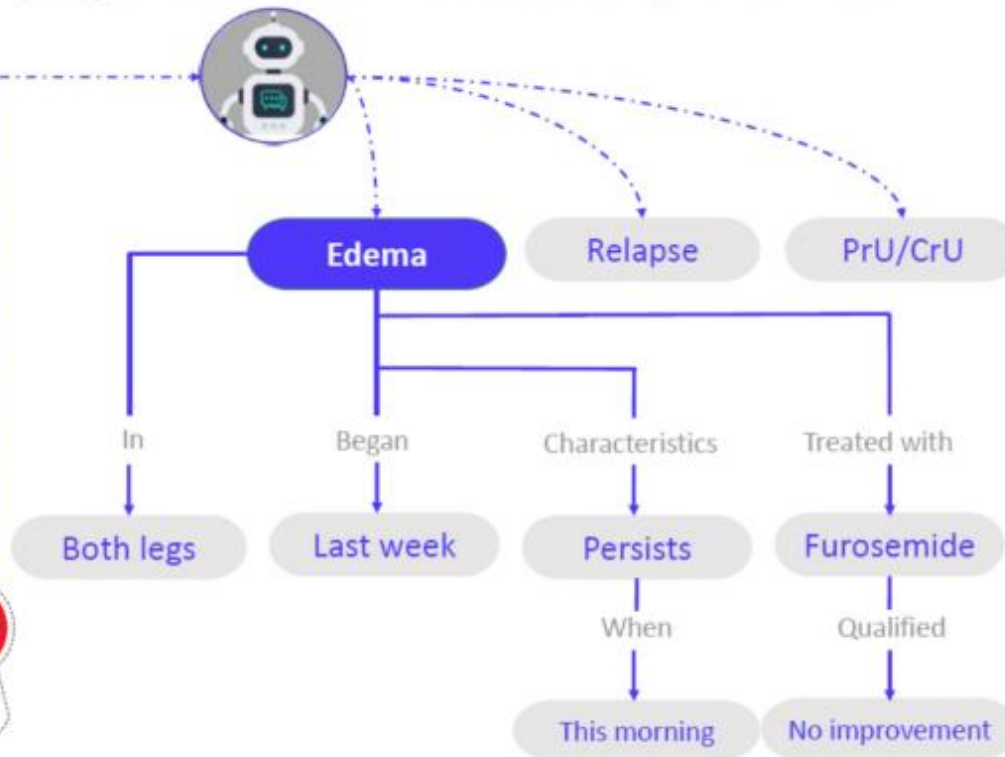
Consultation for **edema** in **both legs** since **last week**.

This **morning** the **edema persists** and there is associated foamy urine.

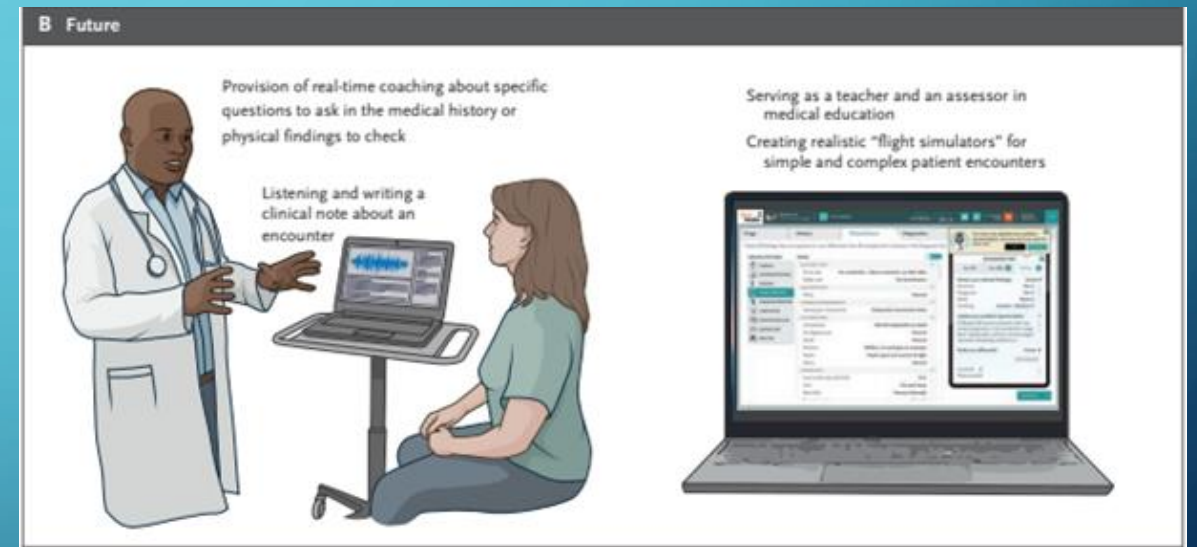
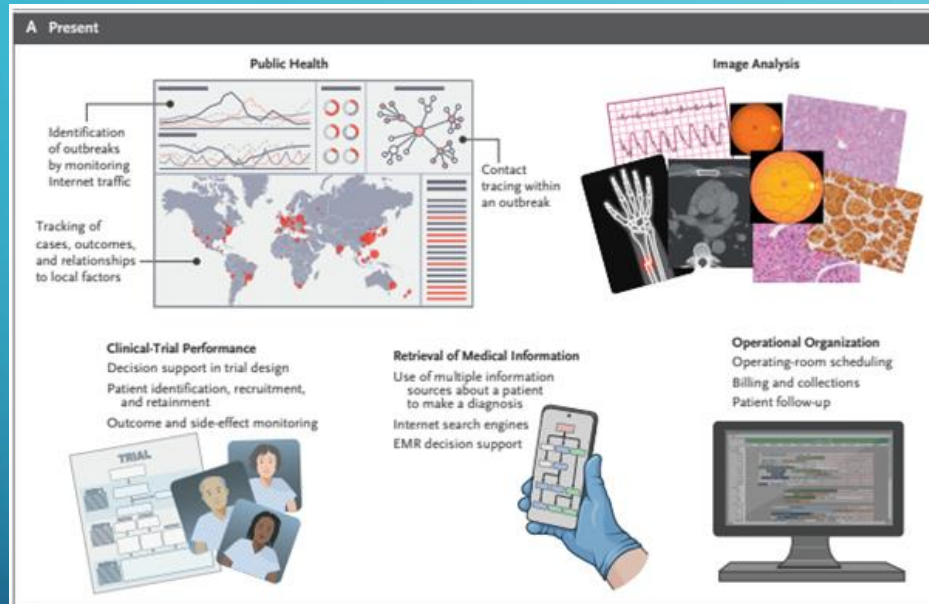
The episode reminds her the last **relapse** of minimal changes a year ago.

She has started **furosemide** 40mg at breakfast since the onset of edema without **improvement**.

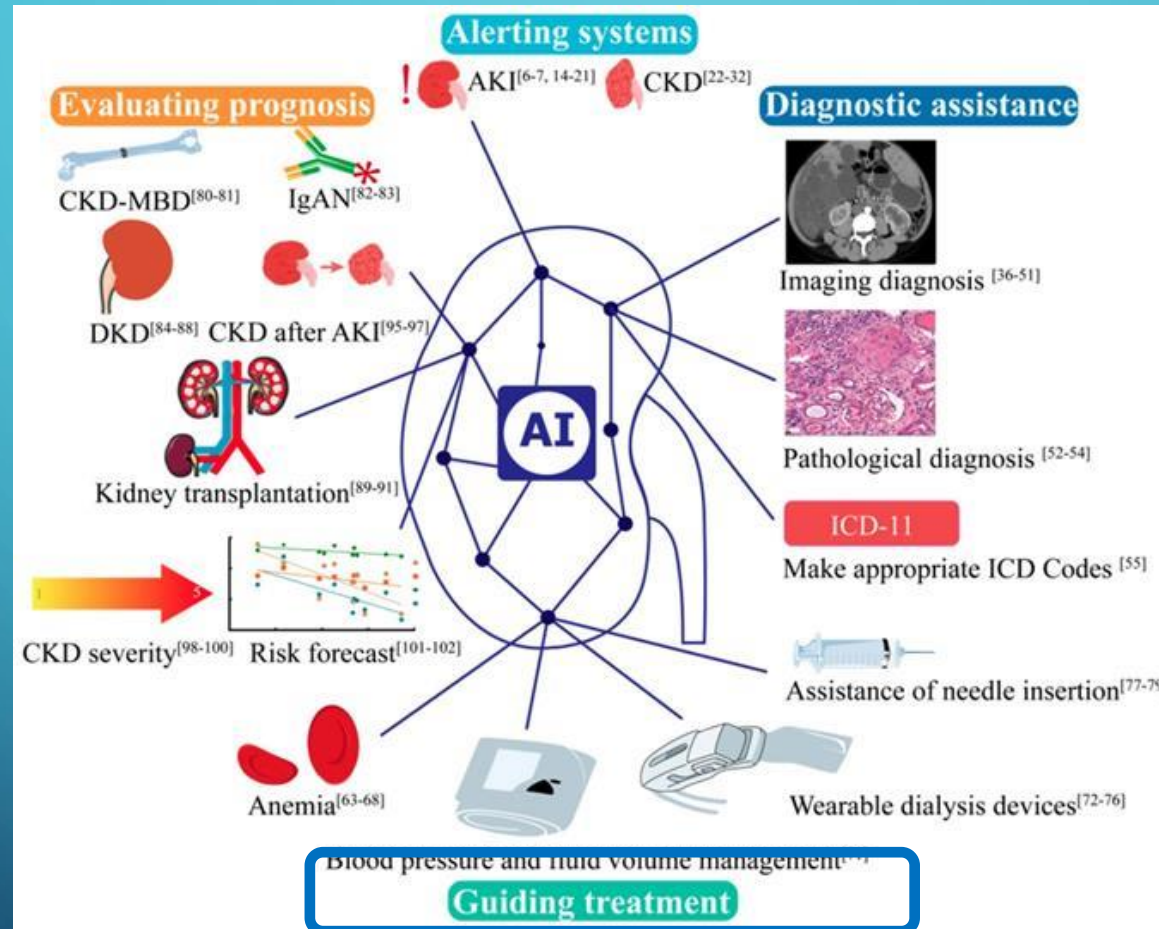
Request **PrU/CrU**.



AI AND CKD: DIAGNOSIS



AI AND CKD: TREATMENT



AI AND CKD: TREATMENT

PREVIOUSLY...



Symptom-based diagnosis

Different types of kidney disease have similar symptoms, so accurate diagnosis is challenging



Non-translatable models

Classical cell culture and animal models have limited translatability



Non-specific treatments

No treatments specifically target the cause of CKD

A NEW ERA IN CKD



IDENTIFY

Understand pathophysiology

With bioinformatics and genomics, we can identify genetic targets and perform revealing diagnostics



VALIDATE

Translatable models

New models allow us to validate targets and test compounds in relevant systems



TREAT

Target the cause

New treatment modalities mean we can aim for previously 'undruggable' targets



CHALLENGES...

- Accessibility to data
- Data quality/ Reliability
- Personal data protection
- Bias
- Support/ Collaboration with specialized personnel

CONCERNS...

- Dehumanization of the human factor
- Disconnection from human sensitivity
- Balance between machine autonomy and the need for human responsibility and supervision



Catalyst | Innovations in Care Delivery

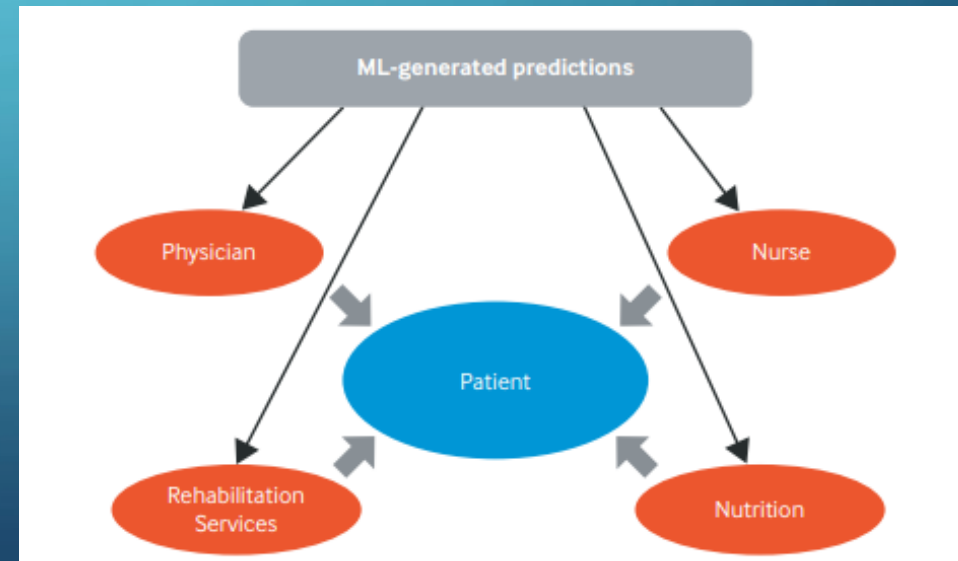
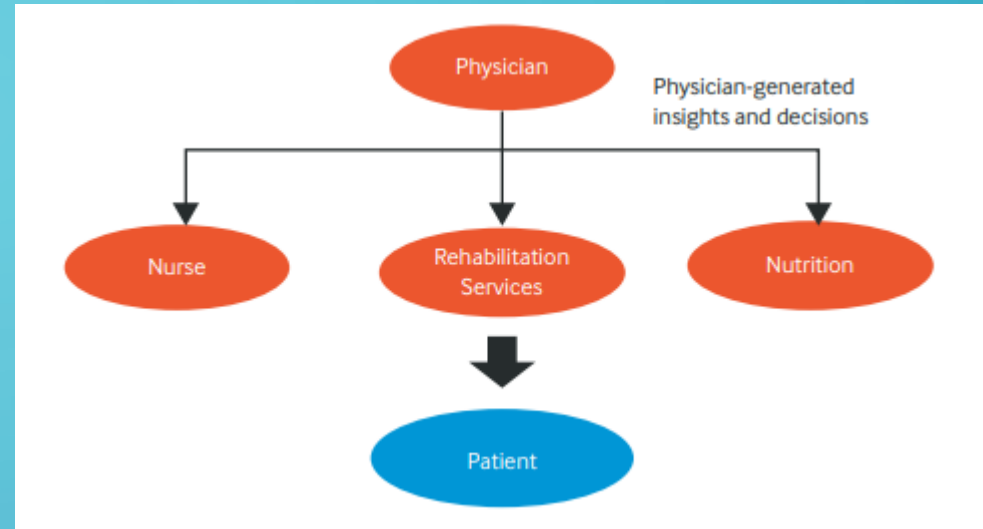
CASE STUDY

Using AI to Empower Collaborative Team Workflows: Two Implementations for Advance Care Planning and Care Escalation

Ron C. Li, MD, Margaret Smith, MBA, Jonathan Lu, MS, Anand Avati, MS, Samantha Wang, MD, MHS, Winifred G. Teuteberg, MD, Kenny Shum, PhD, Grace Hong, Briththa Seevaratnam, MS, Jerri Westphal, MSN, RN, CNML, Margaret Dougherty, MHA, MS, OTR/L, Pooja Rao, MS, OTR/L, CSRS, Steven Asch, MD, MPH, Steven Lin, MD, Christopher Sharp, MD, Lisa Shieh, MD, PhD, Nigam H. Shah, MBBS, PhD

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ARTIFICIAL INTELLIGENCE