Enfeksiyon Hastalıkları Pratiği Dönüşüyor

Tayibe BAL

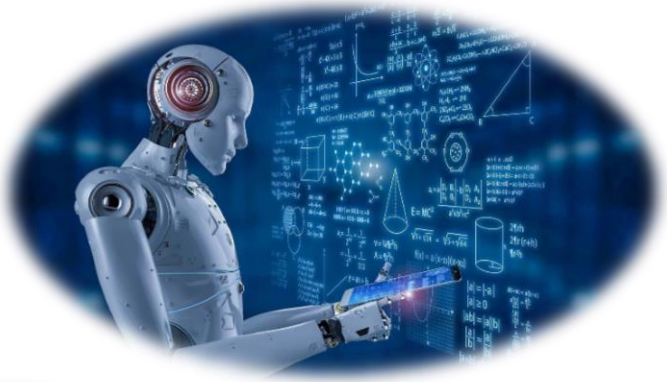
Sunum planı

1. Yapay zeka nedir ?
2. Enfeksiyon hastalıkları pratiğini dönüştüren uygulama örnekleri
   - Tanıda
   - Tedavide
   - Korunmada
3. Hasta sonuçlarına ve sağlık sistemine olumlu etkileri
4. Karşılaşılan zorluklar ve alınan dersler
5. Sonuç

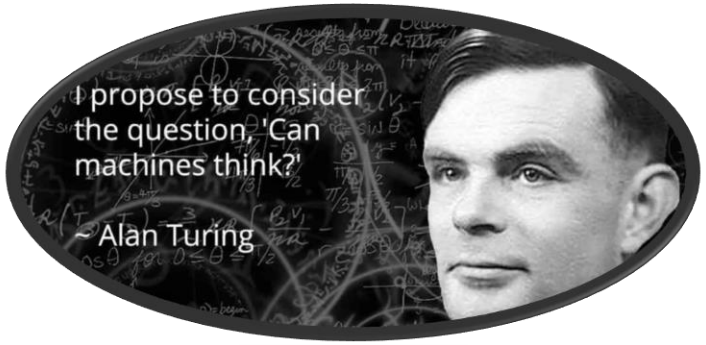
Yeni bir gerçeklik

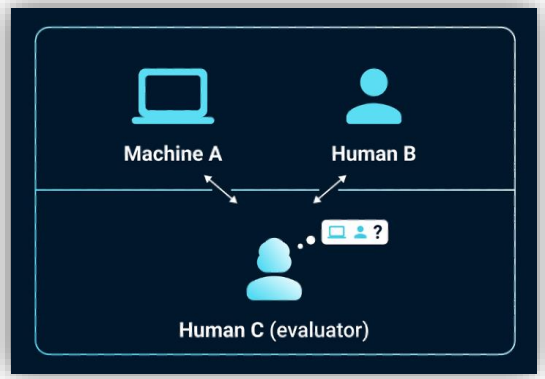
1 Yapay zeka tam olarak nedir ?

- **Teoride:** Akıllı görevleri yerine getirebilen makineler inşa etmekle ilgilenen bilgisayar bilimi dalı



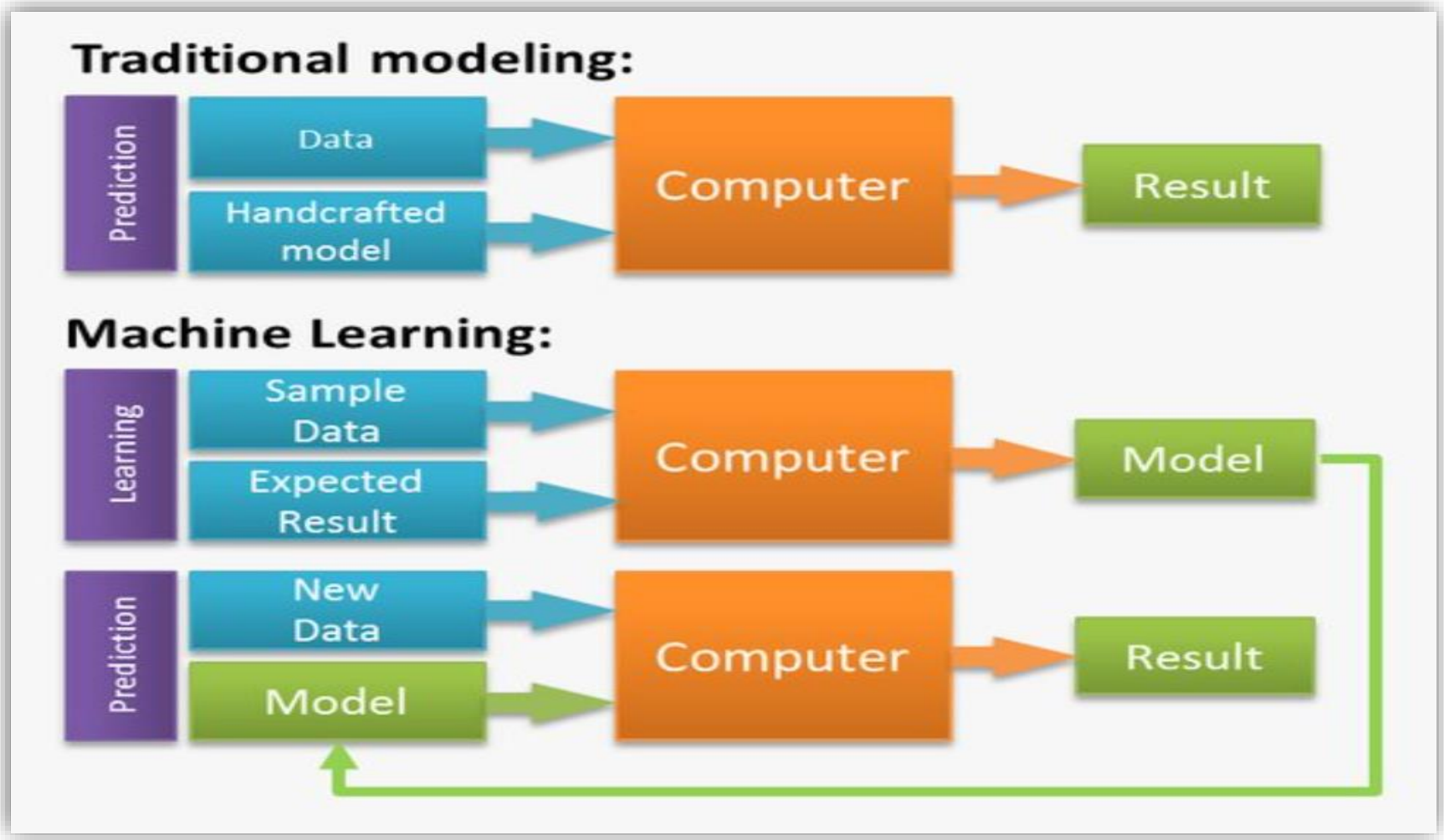
- **Pratikte:**
  - Dijital yoldaş
  - Yeni bir dijital tür





- **1950**
  - Computing machinery and intelligence
  - Turing test
- **1956**
  - Dartmouth Summer Research Project
- **1957**
  - The General Problem Solver was created
- **1964-66**
  - ELIZA computer program was created
- **1973**
  - British and U.S. governments ended support to AI research
- **1980**
  - Japan increased AI funding, followed by United States
- **1997**
  - IBM's Deep Blue chess playing program defeated world champion Gary Kasparov
- **2015**
  - Google's Alpha Go defeated world champion in board game 'Go' using deep learning
- **Present**
  - Most AI applications use artificial neuronal networks and deep learning

Makine öğrenimi nedir ? nasıl çalışır ?



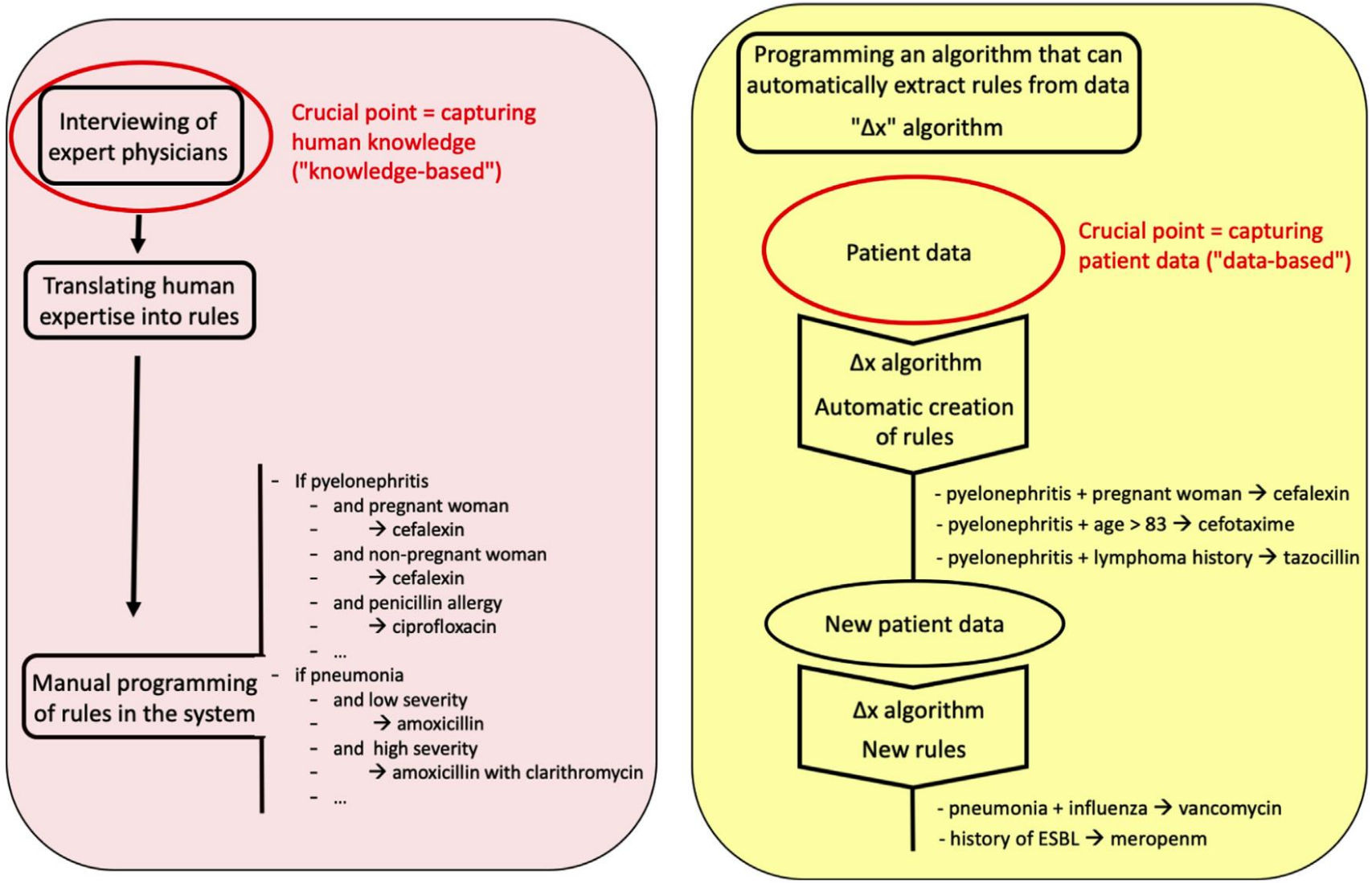
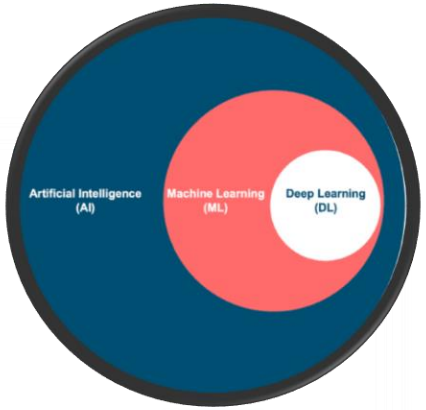


Fig. 1. Artificial intelligence for clinical infectious diseases.

Machine learning (ML)



- Supervised learning: labelled data
  - Classification: categorical data
  - Regression: continuous data
- Unsupervised learning: unlabelled data
  - Data clustering
  - Feature extraction
  - Dimensionality reduction
- Reinforcement learning: environment-driven

Variable to be predicted for NEW data

Unique ID

A number of predictors or features

Target label

Protein ID	Trans-membrane	Membrane probability	Secrete probability	Subcellular location	Signal peptide	Date collected	Vaccine candidate
Q695T9	3	0.76	0.43	Membrane	N	1/05/2019	Yes
Q695U0	0	0.49	0.26	Interior	N	12/07/2019	No
Q27895	0	0.26	0.89	Secreted	Y	3/08/2019	Yes
Q27002	1	0.52	0.30	Interior	N	4/10/2019	Yes
Q26997	0	0.15	0.27	Interior	Y	5/10/2019	No

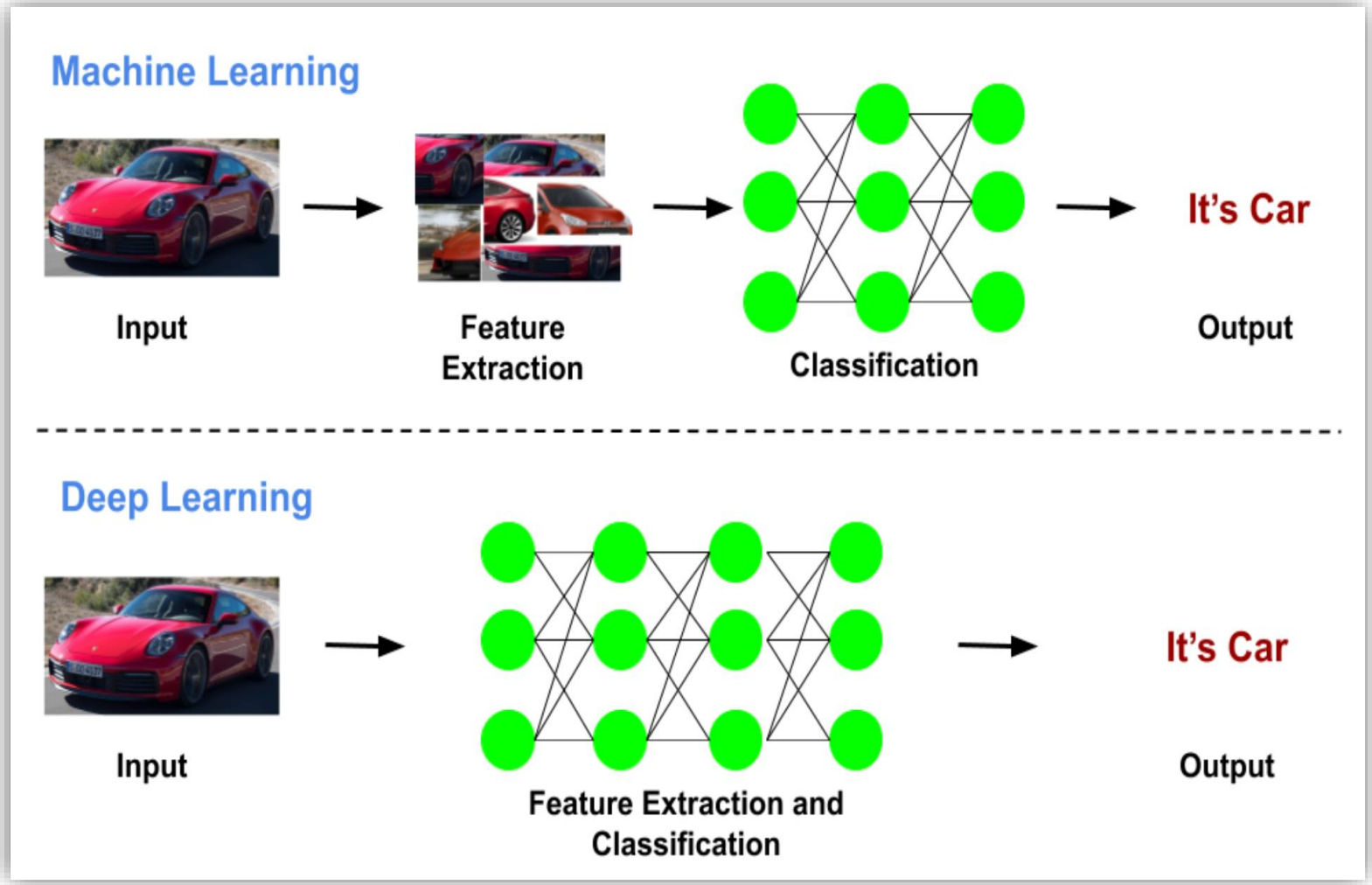
Different data types

New Data

Q26865	2	0.62	0.21	Membrane	N	24/10/2019	?

Variable to be predicted for NEW data

Derin öğrenme nedir ? nasıl çalışır ?



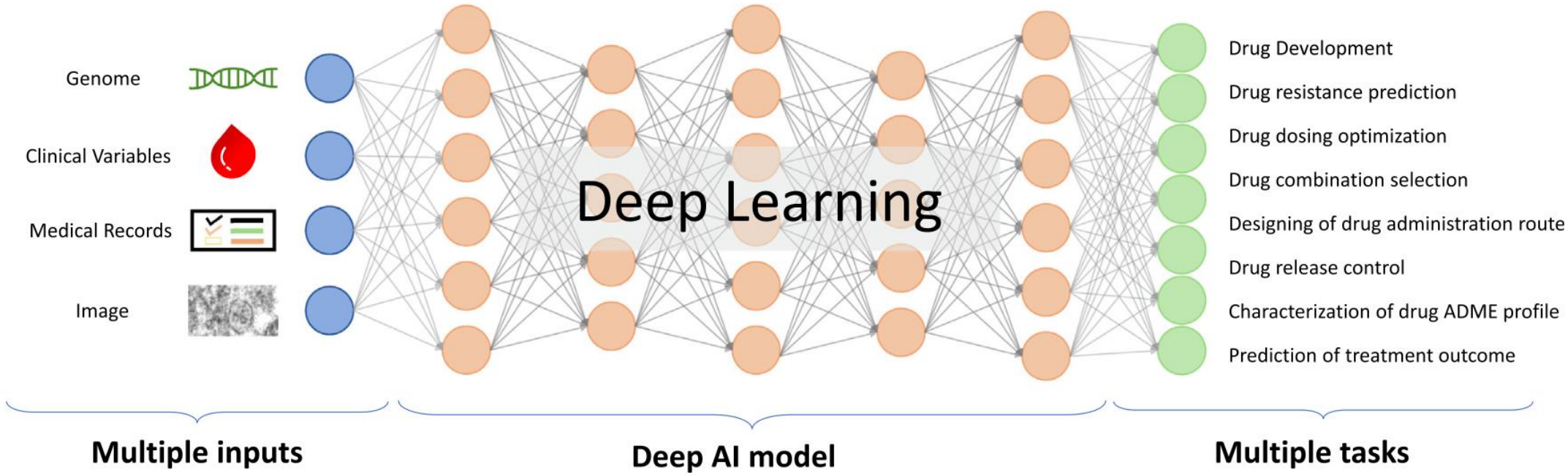


Fig. 4. Multiple Inputs Multiple Outputs framework using deep learning method.

2 Enfeksiyon hastalıkları pratiğini dönüştüren uygulama örnekleri

- Tahmin modelleri
- Otomatize tanı sistemleri
- ML-CDSS (ML tabanlı klinik karar destek sistemleri)
- İlaç ve aşı geliştirilmesi
- Anlık sürveyans (ilaç direnci takibi, salgınların erken tespiti)
- Salgın izlemi ve yönetimi

Tanıda

Enfeksiyon hastalıklarının öngörülmesinde

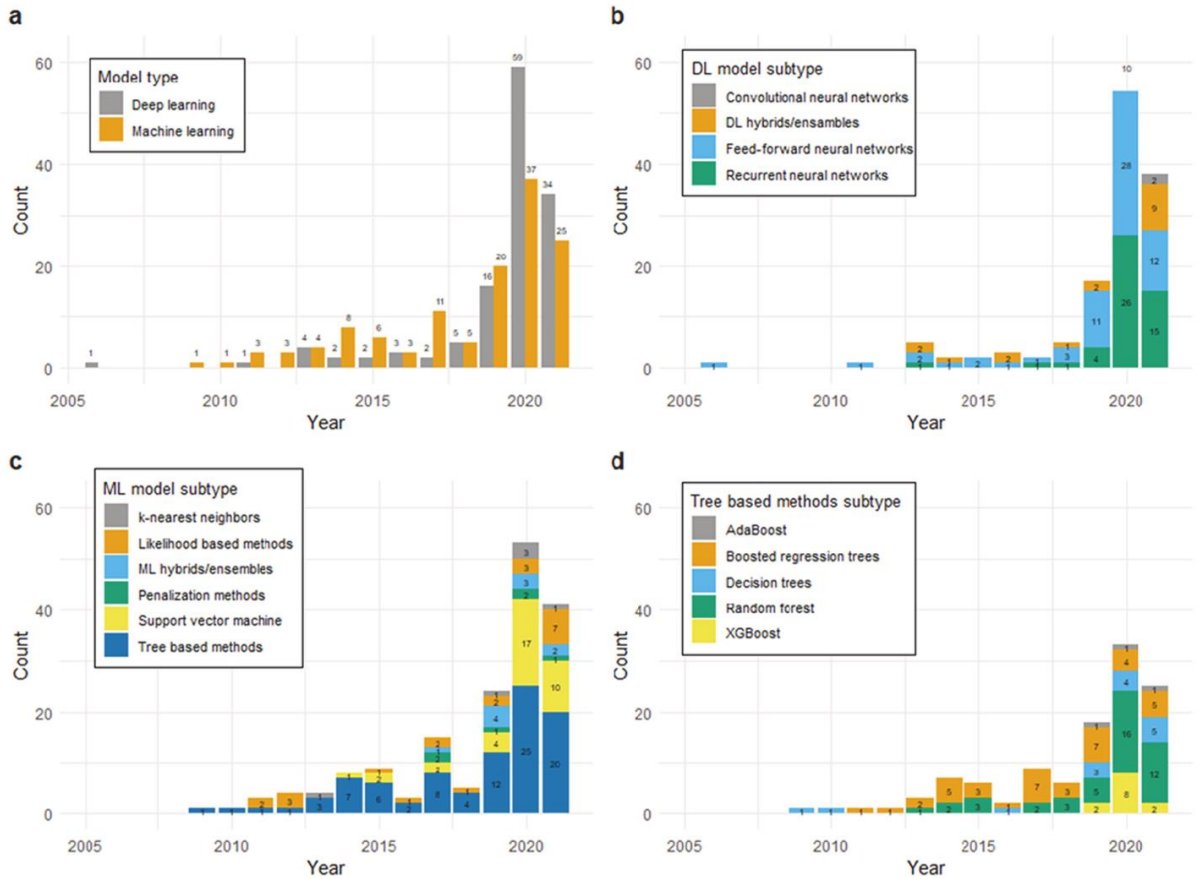
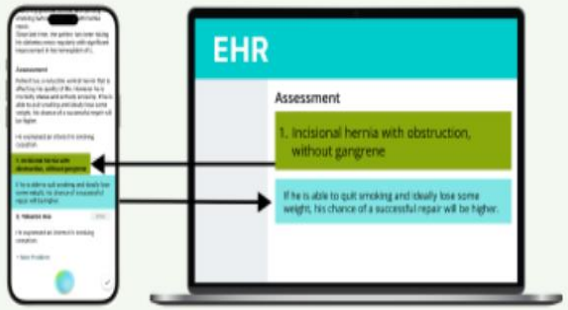


Fig. 4. Trend and extent of ID prediction models published (January 2001–May 2021): Number of citations placed by a) model types (i.e., ML or DL) b) DL model subtypes c) ML model subtypes d) Tree-based ML model subtypes. Note: if an article contained models from different types or subtypes, it was placed in each respective group.

Klinik değerlendirmede ve ayırıcı tanıda

Suki

Why Suki? | Suki Assistant | Suki Compose | Partnerships | About | Contact Sales



Ambient problem based charting.

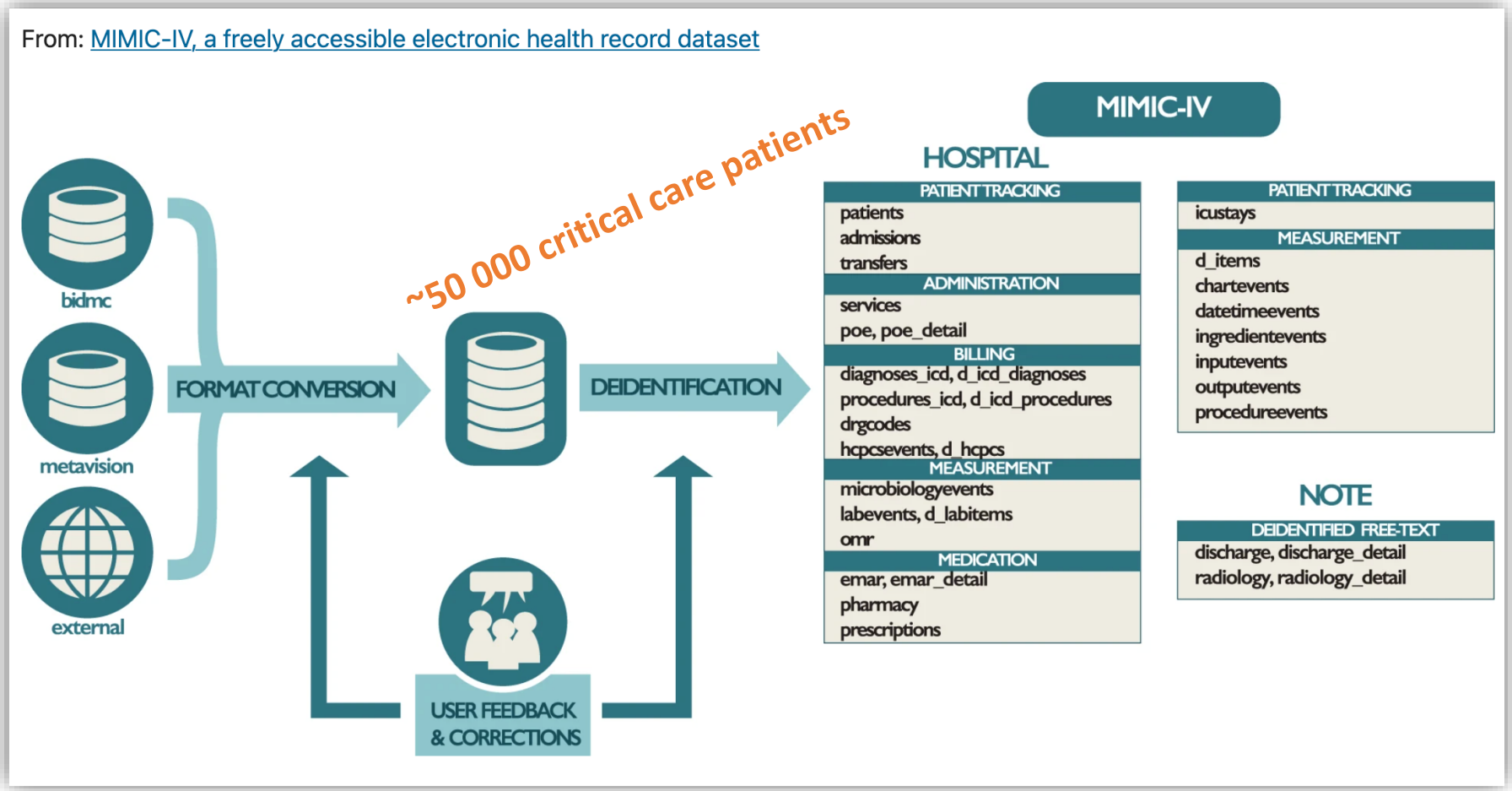
Suki pulls diagnoses from the EHR into the Assessment and Plan and generates content for each based on the encounter.

No copy/paste.

Completed notes are sent back to the EHR, where the relevant sections are updated.

Klinik karar desteğinde (Sepsiste ML-CDSS)

From: MIMIC-IV, a freely accessible electronic health record dataset



Sepsisin tahmini, erken tespiti veya sınıflandırılmasında

Critical care

Effect of a machine learning-based severe sepsis prediction algorithm on patient survival and hospital length of stay: a randomised clinical trial

PDF

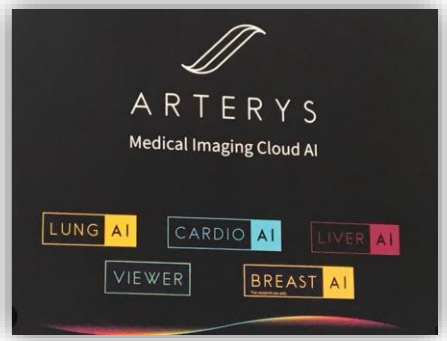
XML

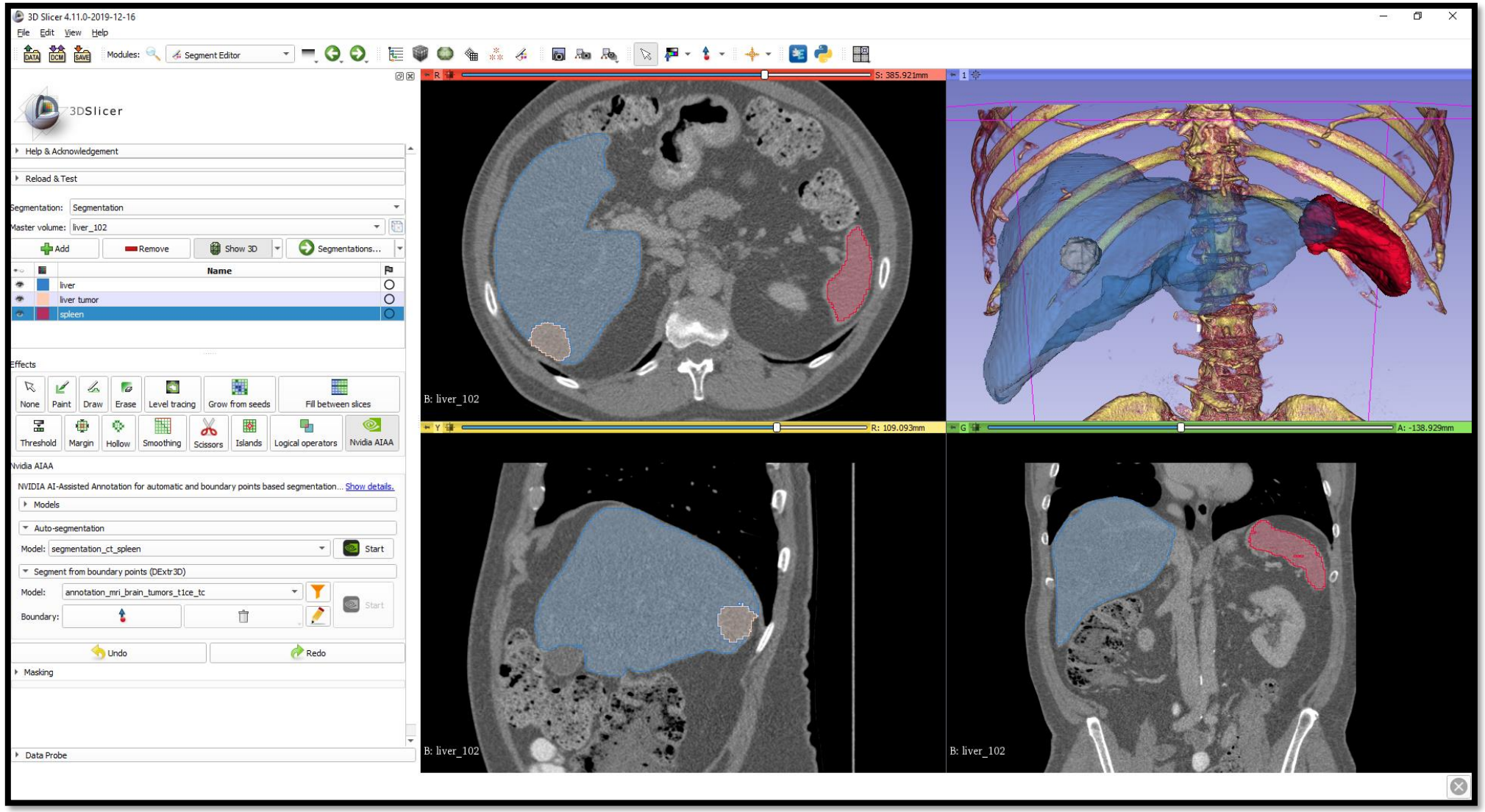
David W Shimabukuro [1], Christopher W Barton [2], Mitchell D Feldman [3], Samson J Mataraso [4, 5] and Ritankar Das [6]

Correspondence to Ritankar Das; ritankar@dascena.com

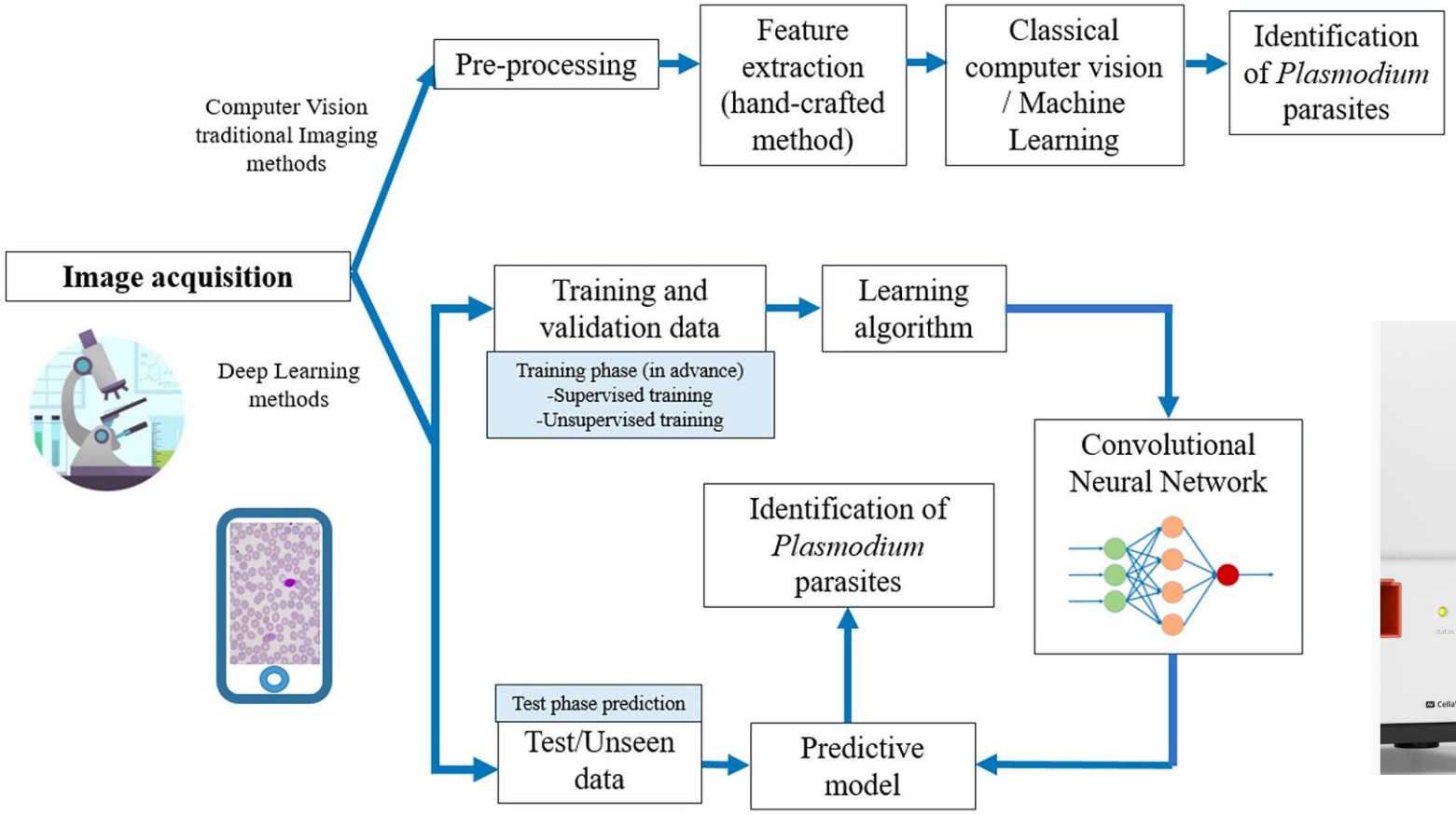
- YBÜ'nde 3 ay süre ile ML algoritması ile bakım alan hastalar (n=67) ve standart bakım alan hastalar (n = 75) karşılaştırılmış
- ML grubunda standart gruba oranla
  - Antibiyoterapiye 2,8 saat daha erken başlanabilmiş
  - Hastanede ve yoğun bakımda yatış sürelerinde anlamlı düşüş
  - Mortalitede anlamlı düşüş görülmüş.

Medikal görüntülemede otomatize tanı




3D Slicer 4.11.0-2019-12-16
File Edit View Help
Modules: Segment Editor
3DSlicer
Help & Acknowledgement
Reload & Test
Segmentation: Segmentation
Master volume: liver_102
Add Remove Show 3D Segmentations...
Name
liver
liver tumor
spleen
Effects
None Paint Draw Erase Level tracing Grow from seeds Fill between slices
Threshold Margin Hollow Smoothing Scissors Islands Logical operators Nvidia AIAA
Nvidia AIAA
NVIDIA AI-Assisted Annotation for automatic and boundary points based segmentation... Show details.
Models
Auto-segmentation
Model: segmentation_ct_spleen
Start
Segment from boundary points (DExtr3D)
Model: annotation_mri_brain_tumors_t1ce_tc
Boundary:
Start
Undo
Redo
Masking
Data Probe
S: 385.921mm
B: liver_102
R: 109.093mm
A: -138.929mm
B: liver_102
B: liver_102

Mikrobiyolojik tanıda



CELLAVISION

FIGURE 3
Representation of the different procedures using Traditional Computer Vision Imaging methods or Deep Learning methods (Convolutional Neural Networks) for malaria parasite identification in thick and thin blood smear samples.

Mikrobiyal kültürlerin öndeğerlendirmesinde

Journal of Microbiological Methods 177 (2020) 106047

Contents lists available at ScienceDirect

Journal of Microbiological Methods

journal homepage: www.elsevier.com/locate/jmicmeth

Clinical evaluation of the APAS® Independence: Automated imaging and interpretation of urine cultures using artificial intelligence with composite reference standard discrepant resolution

Lisa Brenton[a,*], Mary Jo Waters[a], Tyman Stanford[b,c], Steven Giglio[b,c]

[a] St. Vincent's Hospital, Melbourne, Australia
[b] LBT Innovations, Adelaide, Australia
[c] Clever Culture Systems, Switzerland

- APAS Independence ile %90,8 hassasiyet ve %92,8 özgüllük elde edildi
- Saatte 200 plaka okuyarak verimliliği artırdı.

Antimikrobiyal direncin tanısında

AMERICAN SOCIETY FOR MICROBIOLOGY | Journal of Clinical Microbiology®

BACTERIOLOGY

Check for updates

Comparison of an Automated Plate Assessment System (APAS Independence) and Artificial Intelligence (AI) to Manual Plate Reading of Methicillin-Resistant and Methicillin-Susceptible *Staphylococcus aureus* CHROMagar Surveillance Cultures

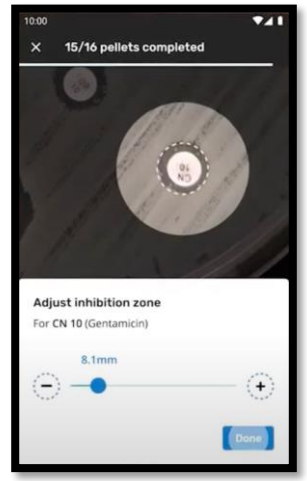
Natalie Gammel,[a] Tracy L. Ross,[a] Shawna Lewis,[b] Melissa Olson,[a] Susan Henciak,[a] Renee Harris,[a] Ann Hanlon,[a] Karen C. Carroll[a,b]

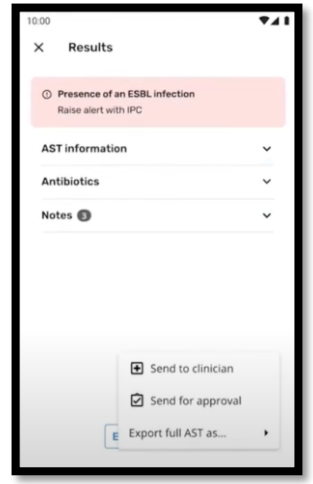
[a]Division of Medical Microbiology, Department of Pathology, the Johns Hopkins Hospital, Baltimore, Maryland, USA
[b]The Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

- 5913 nazal sürüntü kültürünün dijital plaka okumasını içeren beş aylık bir öğrenme dönemi sonrasında
  - %100 negatif prediktif değer ile 2021'de FDA onayı aldı

Antibiogo

World Health Organization





BD Kiestra™ Total Lab Automation (TLA) System

Help maximize your microbiology laboratory efficiencies

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Overview

From sample processing to result reporting, the BD Kiestra™ TLA system offers a complete microbiology laboratory automation solution.

Tedavide

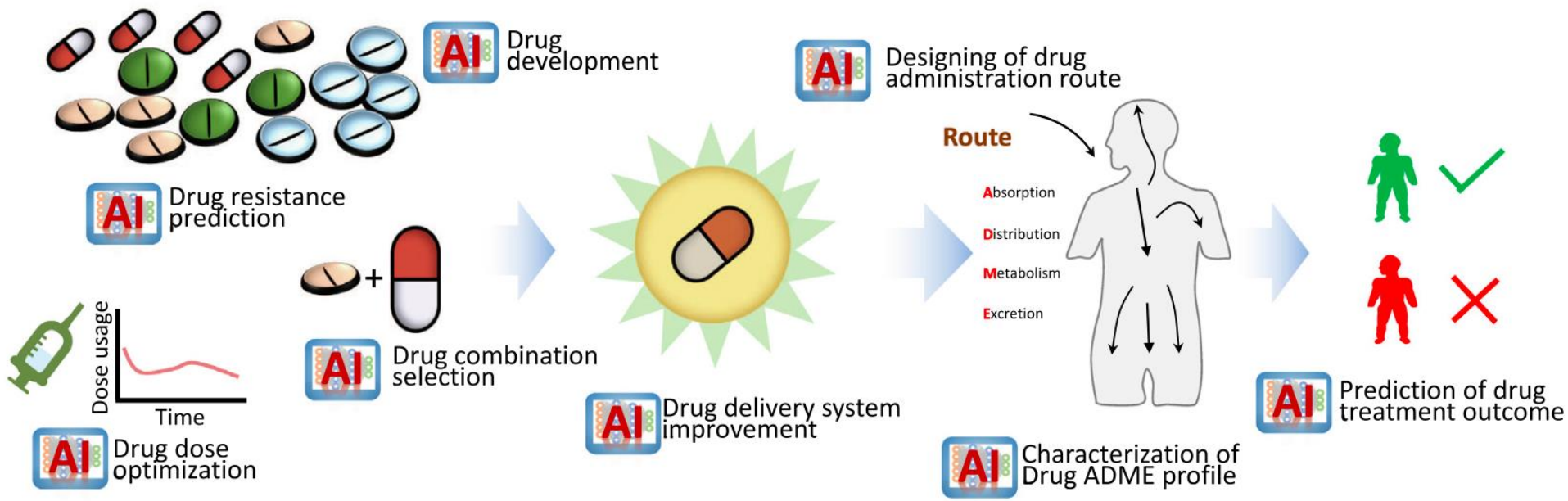


Fig. 3. Current research and applications of AI on drug delivery for infectious disease treatment.

İlaç ve aşı geliştirilmesinde

BROAD INSTITUTE

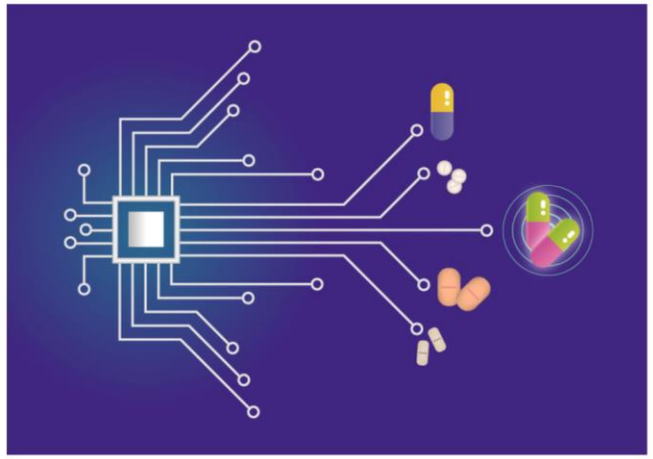
HOME | NEWS

Artificial intelligence yields new antibiotic

A deep-learning model identifies a powerful new drug that can kill many species of antibiotic-resistant bacteria.

By Anne Trafton, MIT News Office

February 20, 2020



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HOME | DATA, SOFTWARE & TOOLS

Drug Repurposing Hub

A resource for advancing therapeutic discovery

nature

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Article | Published: 08 May 2024

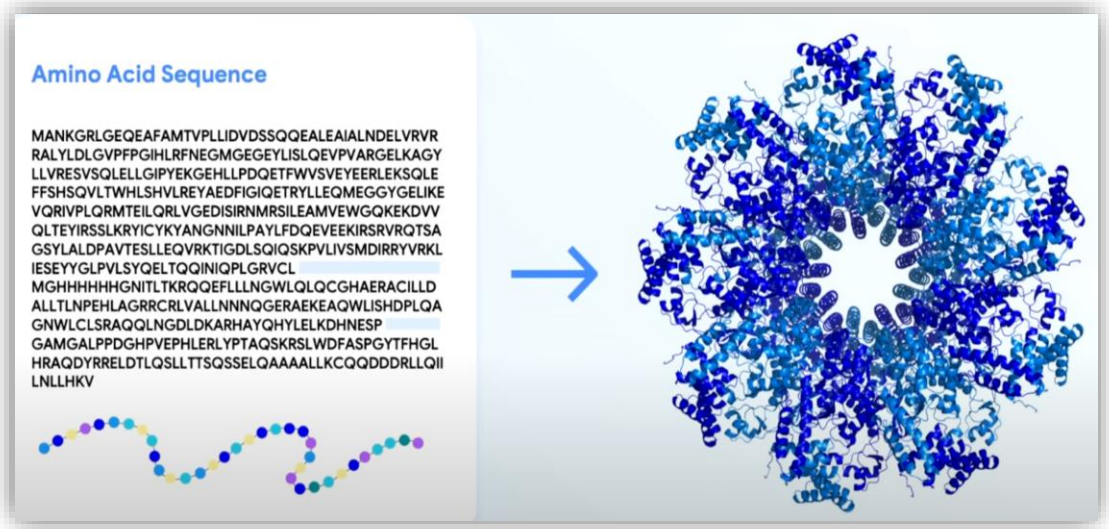
Accurate structure prediction of biomolecular interactions with AlphaFold 3

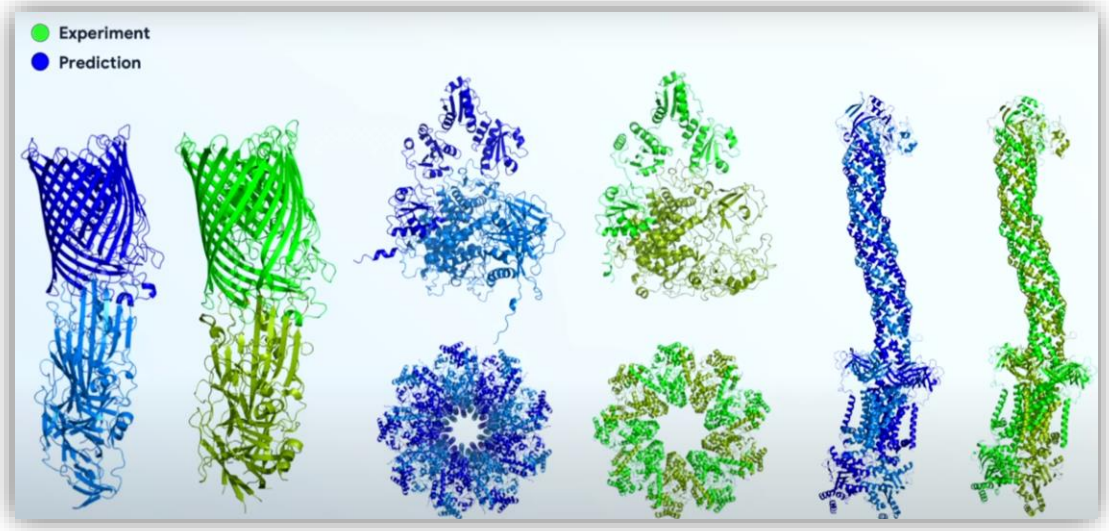
+ RNA + DNA + ligand

Josh Abramson, Jonas Adler, Jack Dunger, Richard Evans, T… der Pritzel, Olaf Ronneberger, Lindsay Willmore, Andrew J. Ballard… tian W. Bodenstein, David A. Evans, Chia-Chun Hung, Michael O'Neill… anyasuvunakool, Zachary Wu, Akvilė Žemgulytė, Eirini Arvaniti, Charl… Alex Bridgland, Alexey Cherepanov, Miles Congreve, … John M. Ju… hors

Nature (2024) | Cite this…

195k Accesses | **1** Citations | **1139** Altmetric | Metrics





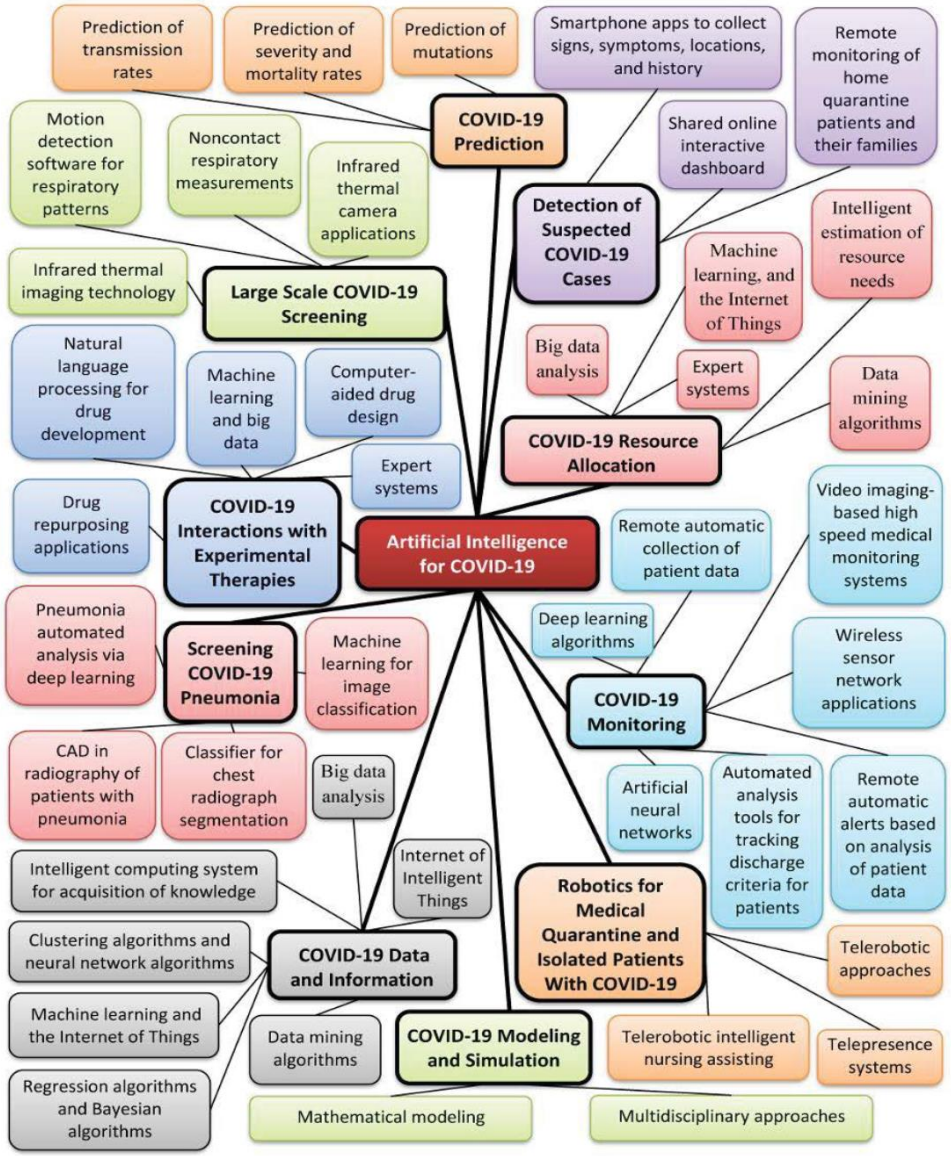
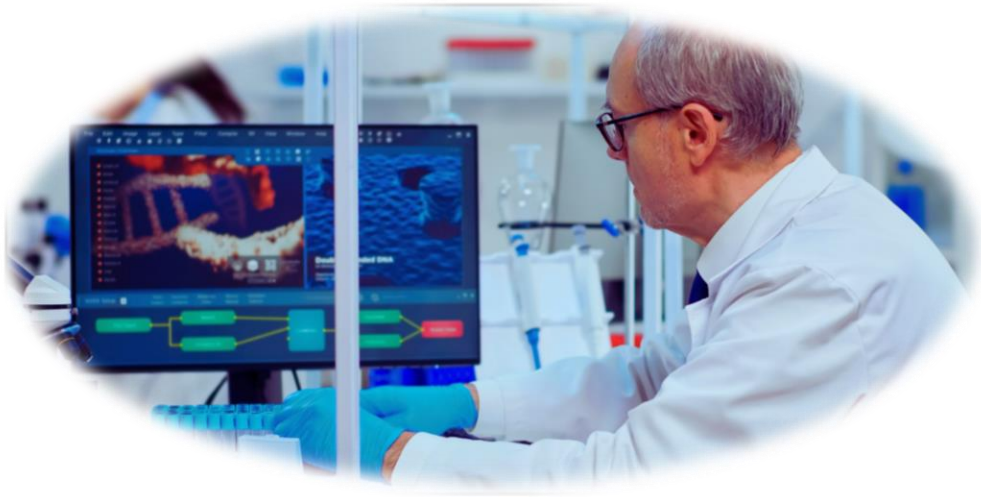
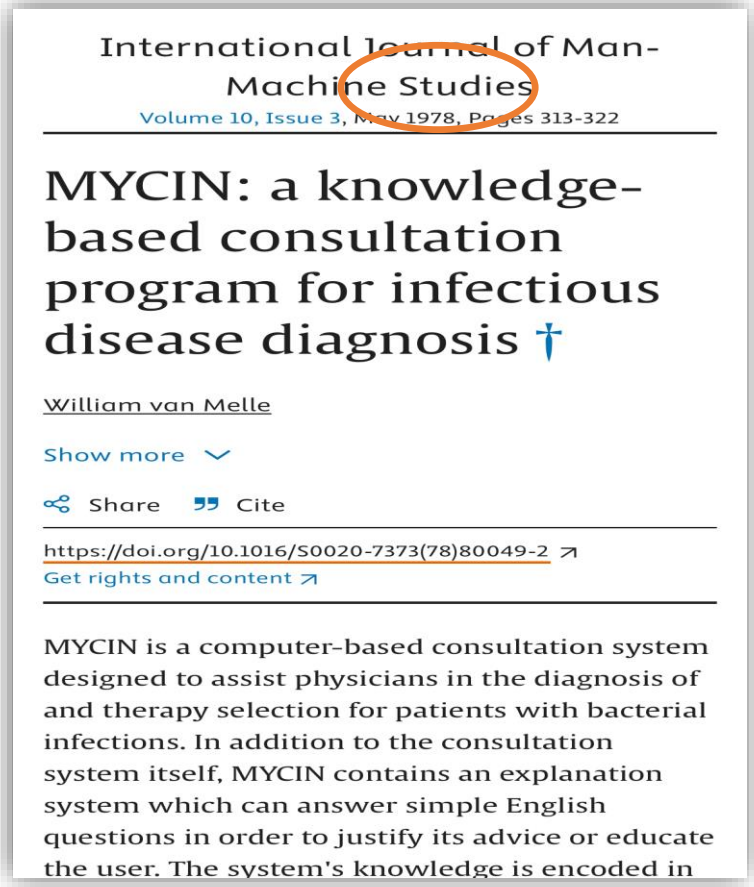


Figure 4: Summary of various AI approaches to address the COVID-19 pandemic [4].

Baricitinib'in ve COVID-19 aşısının keşfi (Vaxign-ML)



Tedavinin optimizasyonunda ?



International Journal of Man-Machine Studies

Volume 10, Issue 3, May 1978, Pages 313-322

MYCIN: a knowledge-based consultation program for infectious disease diagnosis †

William van Melle

Show more

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https://doi.org/10.1016/S0020-7373(78)80049-2

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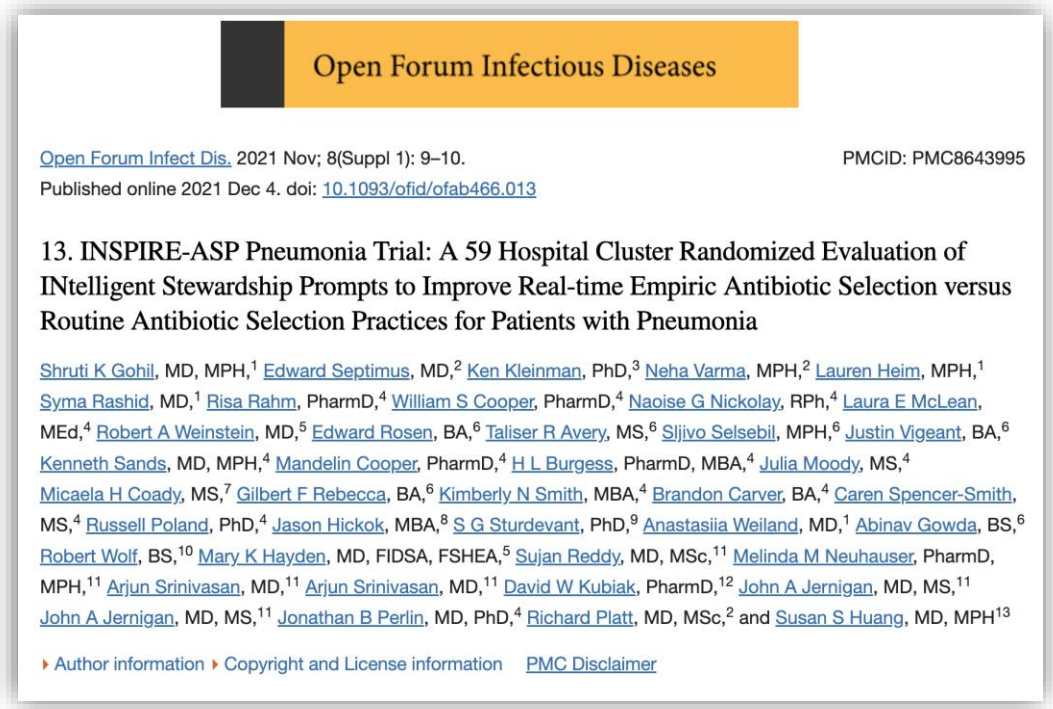
MYCIN is a computer-based consultation system designed to assist physicians in the diagnosis of and therapy selection for patients with bacterial infections. In addition to the consultation system itself, MYCIN contains an explanation system which can answer simple English questions in order to justify its advice or educate the user. The system's knowledge is encoded in



Open Forum Infectious Diseases

Open Forum Infect Dis. 2021 Nov; 8(Suppl 1): 9–10. PMCID: PMC8643995
Published online 2021 Dec 4. doi: 10.1093/ofid/ofab466.013

13. INSPIRE-ASP Pneumonia Trial: A 59 Hospital Cluster Randomized Evaluation of INtelligent Stewardship Prompts to Improve Real-time Empiric Antibiotic Selection versus Routine Antibiotic Selection Practices for Patients with Pneumonia

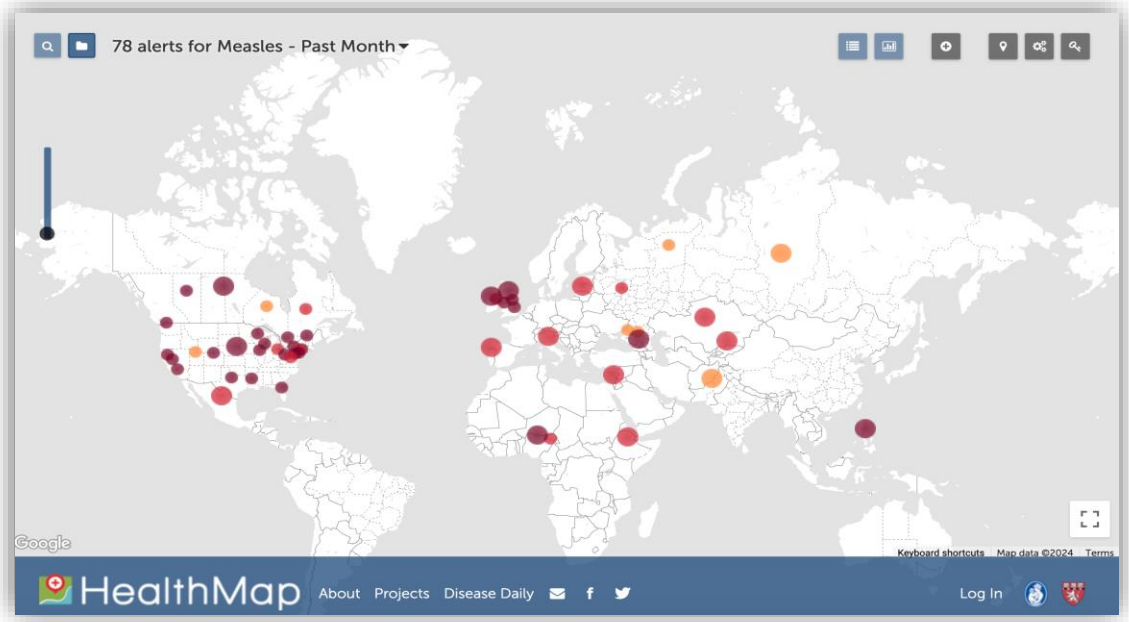
Shruti K Gohil, MD, MPH,[1] Edward Septimus, MD,[2] Ken Kleinman, PhD,[3] Neha Varma, MPH,[2] Lauren Heim, MPH,[1] Syma Rashid, MD,[1] Risa Rahm, PharmD,[4] William S Cooper, PharmD,[4] Naoise G Nickolay, RPh,[4] Laura E McLean, MEd,[4] Robert A Weinstein, MD,[5] Edward Rosen, BA,[6] Taliser R Avery, MS,[6] Sljivo Selsebil, MPH,[6] Justin Vigeant, BA,[6] Kenneth Sands, MD, MPH,[4] Mandelin Cooper, PharmD,[4] H L Burgess, PharmD, MBA,[4] Julia Moody, MS,[4] Micaela H Coady, MS,[7] Gilbert F Rebecca, BA,[6] Kimberly N Smith, MBA,[4] Brandon Carver, BA,[4] Caren Spencer-Smith, MS,[4] Russell Poland, PhD,[4] Jason Hickok, MBA,[8] S G Sturdevant, PhD,[9] Anastasiia Weiland, MD,[1] Abinav Gowda, BS,[6] Robert Wolf, BS,[10] Mary K Hayden, MD, FIDSA, FSHEA,[5] Sujan Reddy, MD, MSc,[11] Melinda M Neuhauser, PharmD, MPH,[11] Arjun Srinivasan, MD,[11] Arjun Srinivasan, MD,[11] David W Kubiak, PharmD,[12] John A Jernigan, MD, MS,[11] John A Jernigan, MD, MS,[11] Jonathan B Perlin, MD, PhD,[4] Richard Platt, MD, MSc,[2] and Susan S Huang, MD, MPH[13]

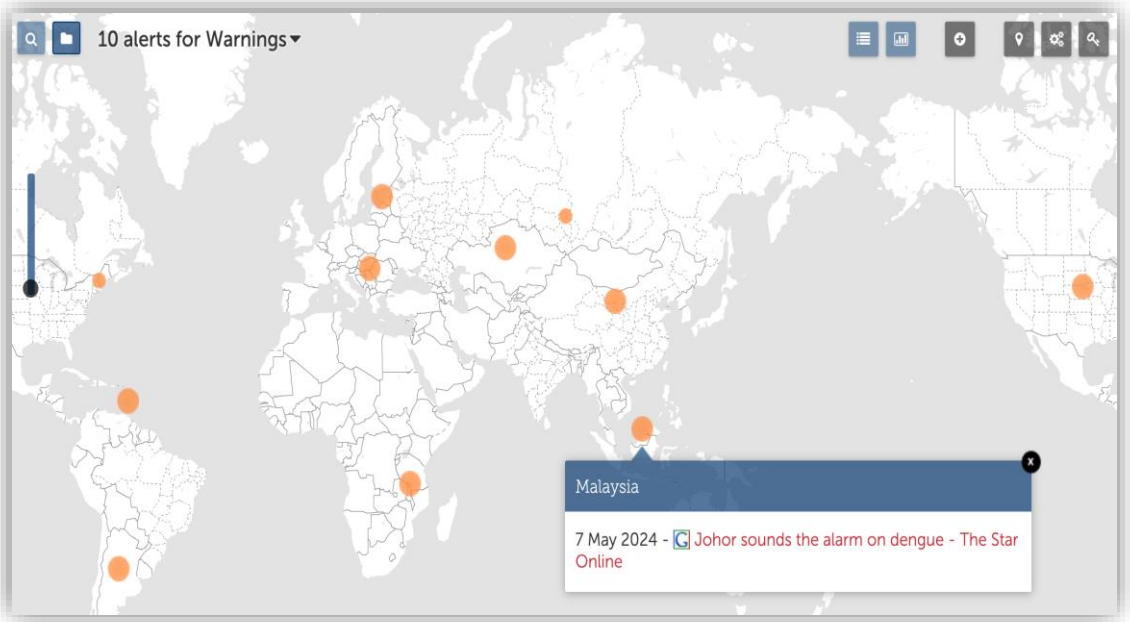
- 12 eyalette 59 hastanede başlangıç ve müdahale dönemlerinde sırasıyla 59.897 ve 51.486 YBÜ dışı pnömoni hastası dahil edilmiş
- Vankomisin ve anti-pseudomonal tedavi sürelerinde, müdahale grubunda rutin bakıma kıyasla %27 ve %33 oranında azalma görülmüş

Korunmada

Salgın tahmininde ve yönetiminde

HealthMap
www.healthmap.org

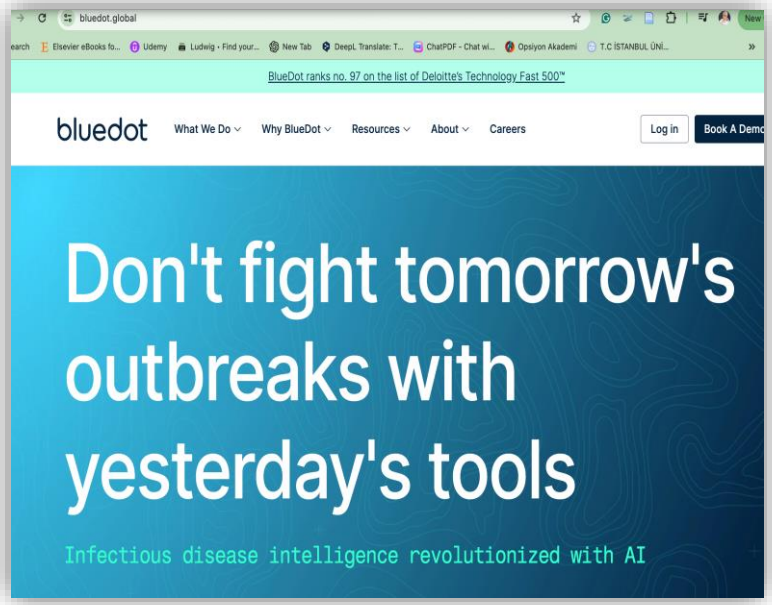




bluedot

www.bluedot.global

Proven history



CDC Influenza (Flu)

Search

Seasonal Flu

About Flu +

Who is at Higher Risk of Flu Complications +

This Flu Season +

Prevent Flu +

Print

Forecasting for Influenza Prevention and Control

Unlike CDC's traditional influenza (flu) surveillance systems, which measure flu activity after it has occurred, flu forecasting provides information about the future, allowing CDC to plan ahead and potentially reduce the impact of flu.

Flu Activity & Surveillance –

CDC's WHO Collaborating Center

Overview of Influenza Surveillance in the United States

Influenza Hospitalization Surveillance Network (FluSurv-NET)

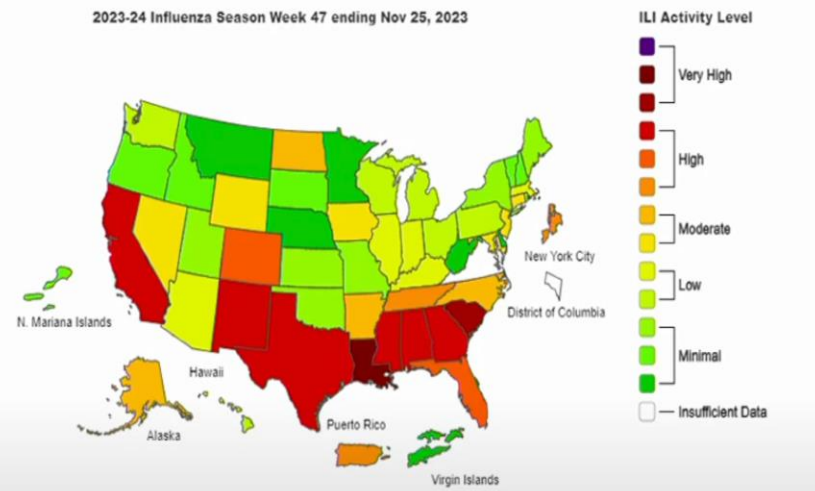
Current United States Flu Activity Map

Weekly U.S. Influenza Surveillance Report (FluView)

FluView Interactive

Past Weekly Surveillance Reports

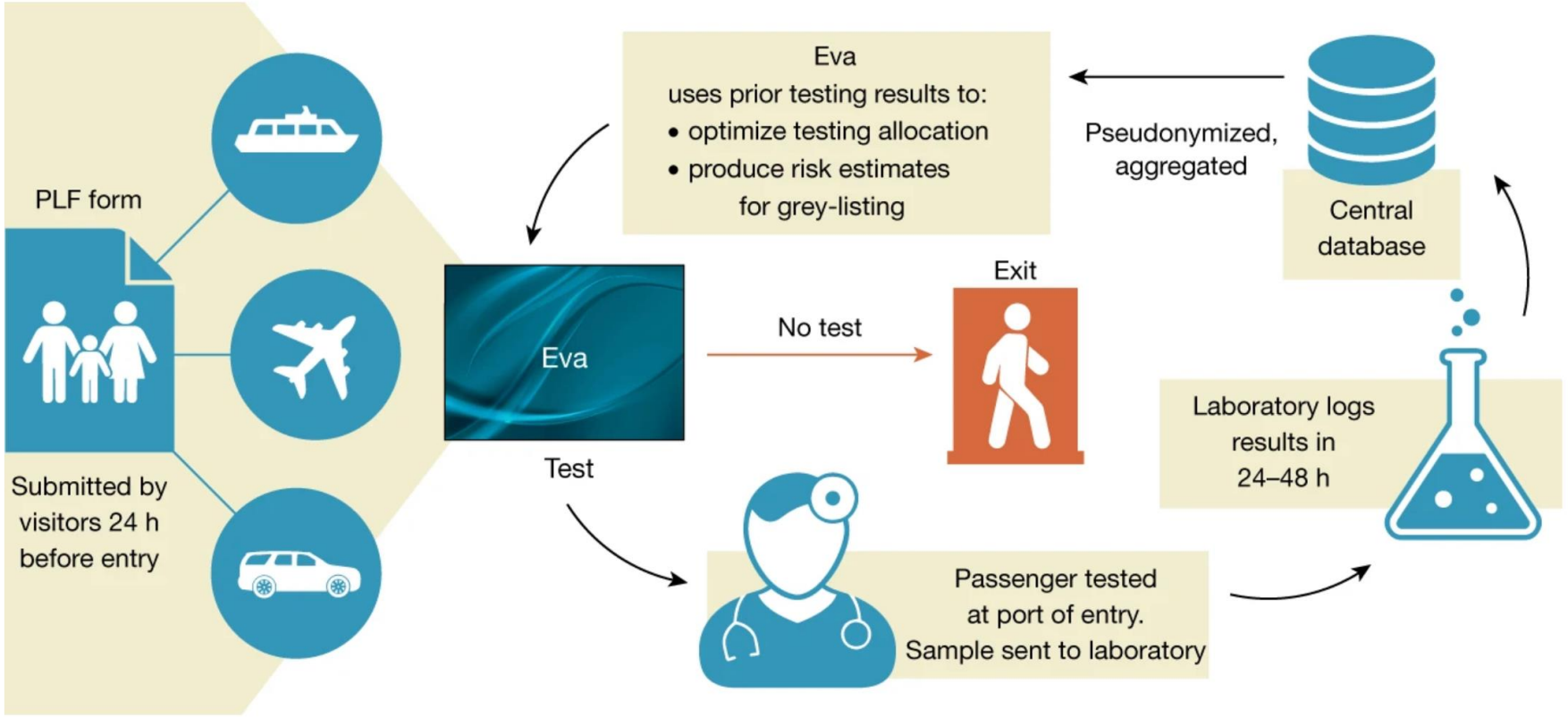
FluSight: Flu Forecasting +



Taramada

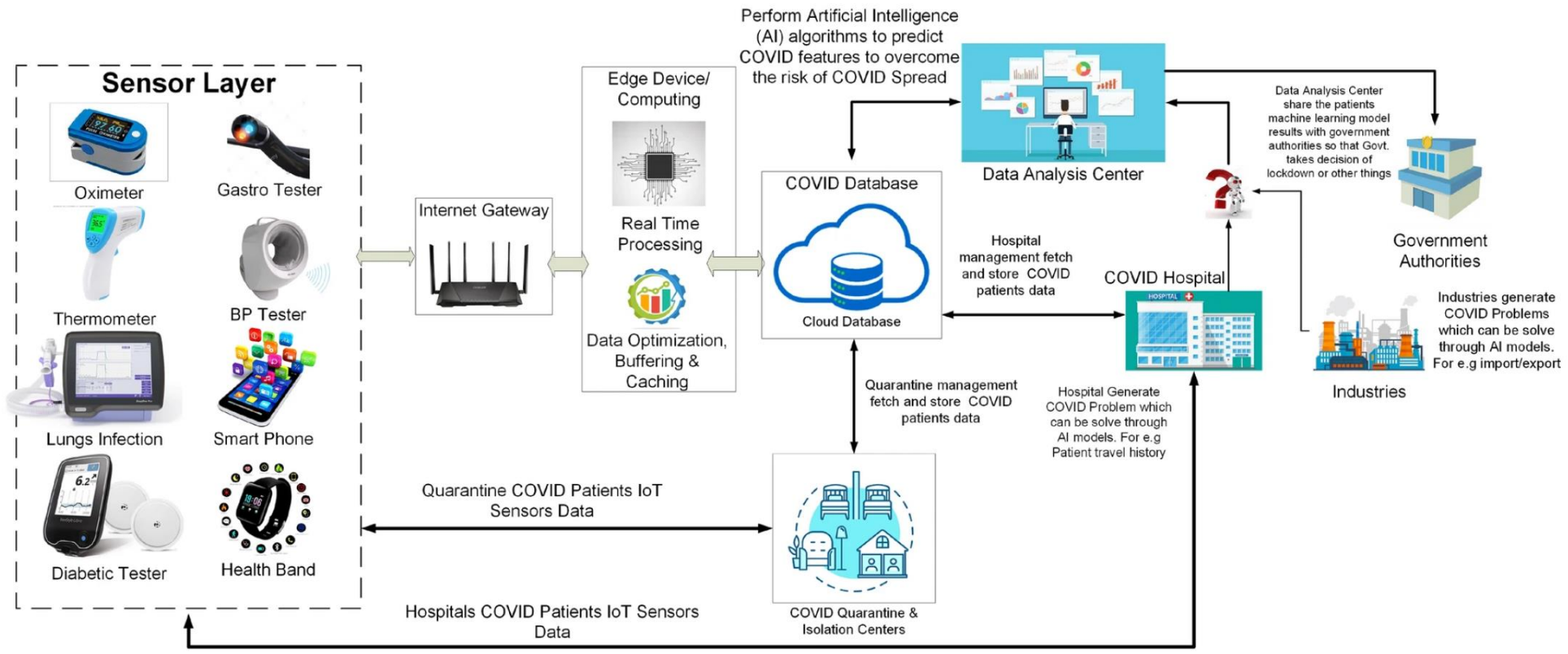
Fig. 1: A reinforcement learning system for COVID-19 testing (Eva).

From: Efficient and targeted COVID-19 border testing via reinforcement learning



Temaslı takibinde

From: COVICT: an IoT based architecture for COVID-19 detection and contact tracing



Proposed IoT architecture for COVID with AI applications

Hasta sonuçlarına ve sağlık sistemine olumlu etkileri

- Erken tanı ve müdahale
- Hastalara özelleştirilmiş tedavi planlaması
- Etkin kaynak yönetimi
- Maliyette azalma

Karşılaşılan zorluklar

- Veri gizliliği ve güvenliği
- Algoritma önyargıları
- Klinik doğrulama
- Şeffaflık olmaması ve bias riski
- Sağlık personelinin YZ okuryazarlığının bulunmaması
- Sürekli güncelleme gereği

5 Sonuç

- Makine öğrenmesi ve derin öğrenme uygulamaları
  - Enfeksiyon hastalıklarının tanısında ve korunmada epey yol katetmiş görünüyorsa da
  - Tedavinin iyileştirilmesinde henüz emekleme aşamasındalar
  - Ancak bu alanda da umut vaat eden adımlar atılmakta
- Tıp profesyonelleri
  - Bu ilerlemeleri takip etmeli ve yorumlayabilmeli
  - Mümkünse bu dönüşümde yer almalı

Teşekkürler