Artificial Intelligence in Universal Health Care

Avinash Supe

Thanks

- Sandhya Ananth, National Disease Modelling Consortium – IIT, Mumbai
- Dr Roy Patankar – Zen Hospital
- Dr Prasad Bhukebag - Zen Hospital

Healthcare Challenges in India

Quality

Access

Affordability

Inequity

Parrey and Aneja 2023

- India is home for best hospitals in world and also there is acute shortage of doctors and nurses

- Ratio of available doctors to population is estimated at 1:1,596 (calculated from Central Bureau of Health Intelligence, 2018). (Low in rural areas)

Healthcare Expenditure

- Expenditure less than <2% of GDP
- 79 per cent of urban households and 72 per cent of rural households accessed private health facilities in 2014 (National Sample Survey Office, 2014).
- 30 per cent of HE is borne by the public sector, patients' out-of-pocket expenses account for the remaining 70 per cent (Rao, 2018)
- Private healthcare space, however, is fragmented and unregulated
- Less than 2% accredited

Healthcare and Poverty

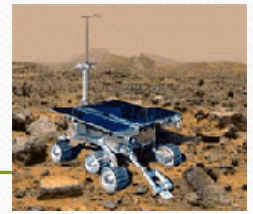
- The high cost of private healthcare is a major driver of persistent poverty: in 2011, 55 million Indians were pushed below the official poverty line due to healthcare costs, with 38 million of these falling below the poverty line due to the high cost of medication (Selvaraj, Farooqui and Karan, 2018).

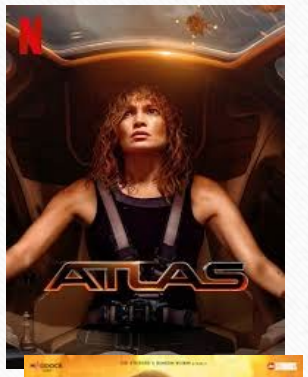
Universal Health Care
What needs to be done ?

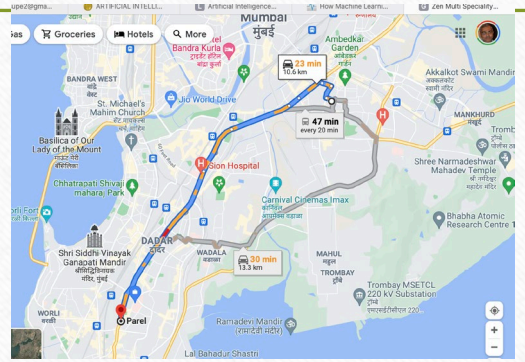
- Strengthening the public health system as the primary provider
- Improving access to quality primary care across the country
- Effectively integrating the private sector
- Increasing government health spending
- Focusing on preventive healthcare
- Addressing regional disparities
- implementing robust health information systems to monitor and manage quality;

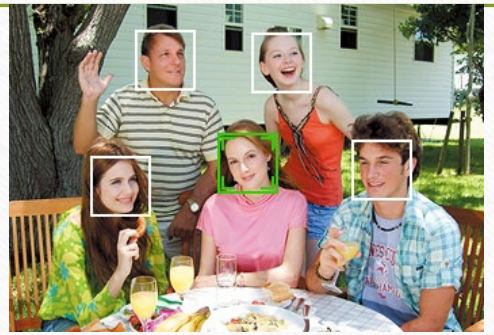
Impact of AI in Healthcare

Artificial Intelligence
has already Entered Our Life









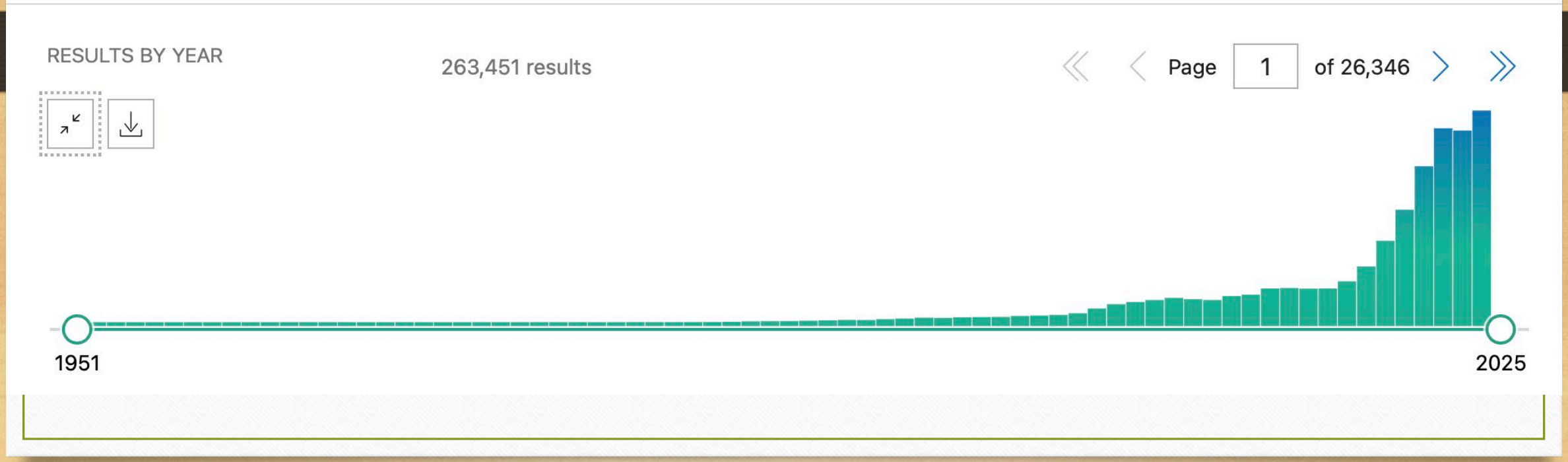
FILMS

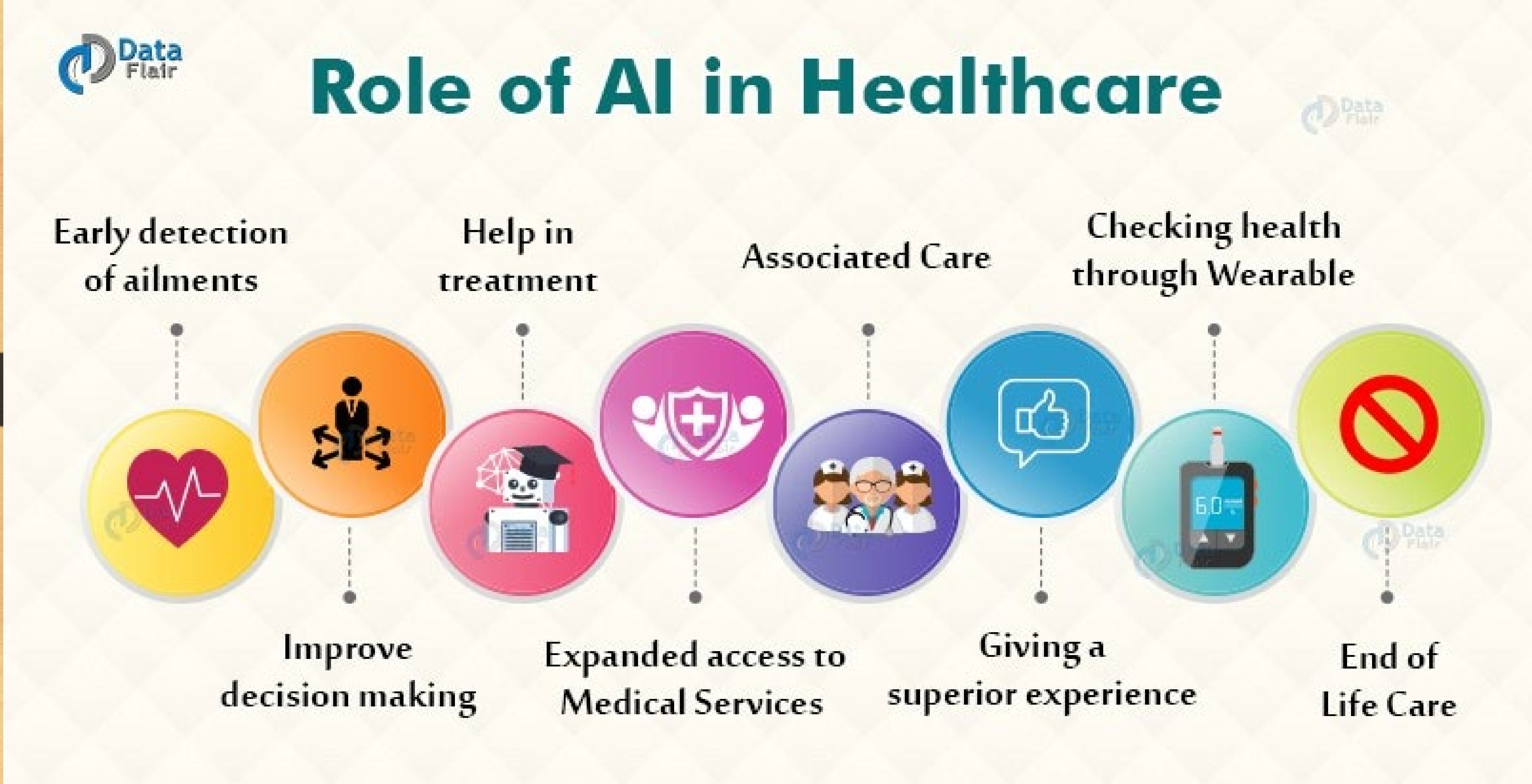
Formal verification

Face detection

Artificial Intelligence in Pubmed

- **263451 Results Mainly in Last 8 Years**





healthcareitnews.com

How can AI help in UHC ?

- **Early Disease Detection**

Early Disease Detection

AI algorithms can analyze medical images like X-rays, CT scans, and MRIs with high accuracy to detect diseases like cancer, tuberculosis, and cardiovascular conditions at early stages, leading to better treatment outcomes and improved survival rates.

19th Century
X-ray based
Screening

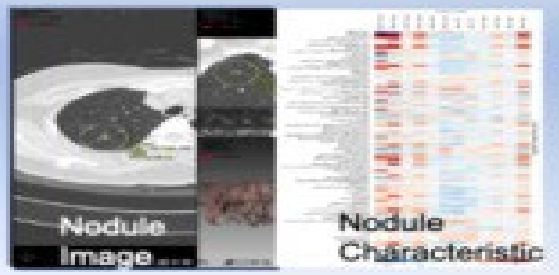
Early 20th Century
LDCT based
Screening

Late 20th Century
3D Volume
Reconstructed
CT
Radiomics
Analysis

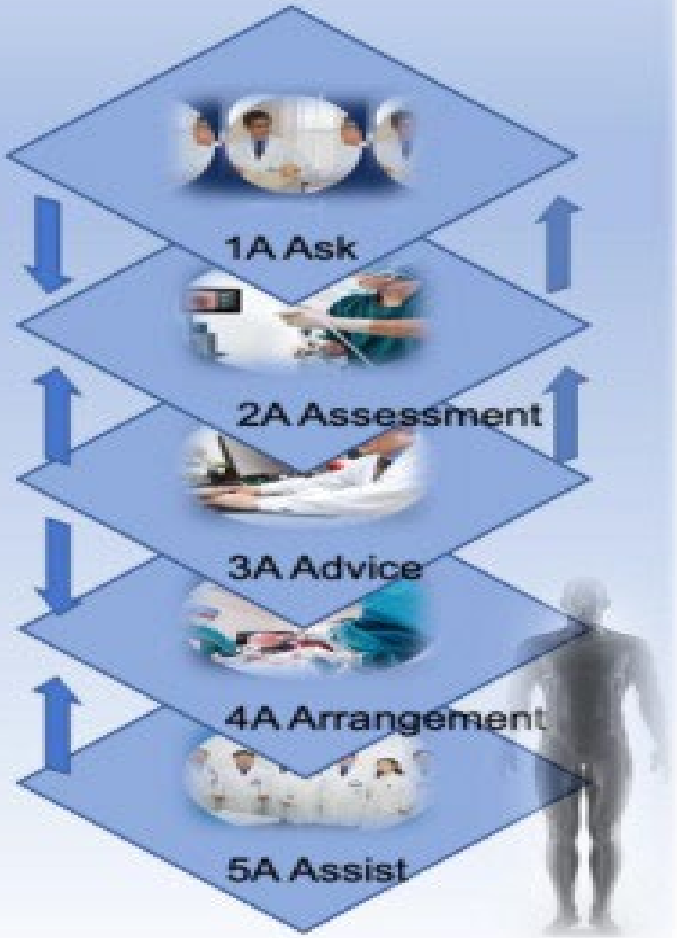
Early 21th Century
AI, VR & AR
Technology

21th Century
BaiDX Pulmonary
Nodule Diagnosis
System

The History of Diagnosis System for Pulmonary Nodule



Radiological reductionism



Individual and Holism

Digital Screening and Diagnosis

Automated parasite identification using microscopic images

Computer Vision for image analysis and quantification

AI powered smartphone applications for remote diagnosis

Machine learning algorithms for classification

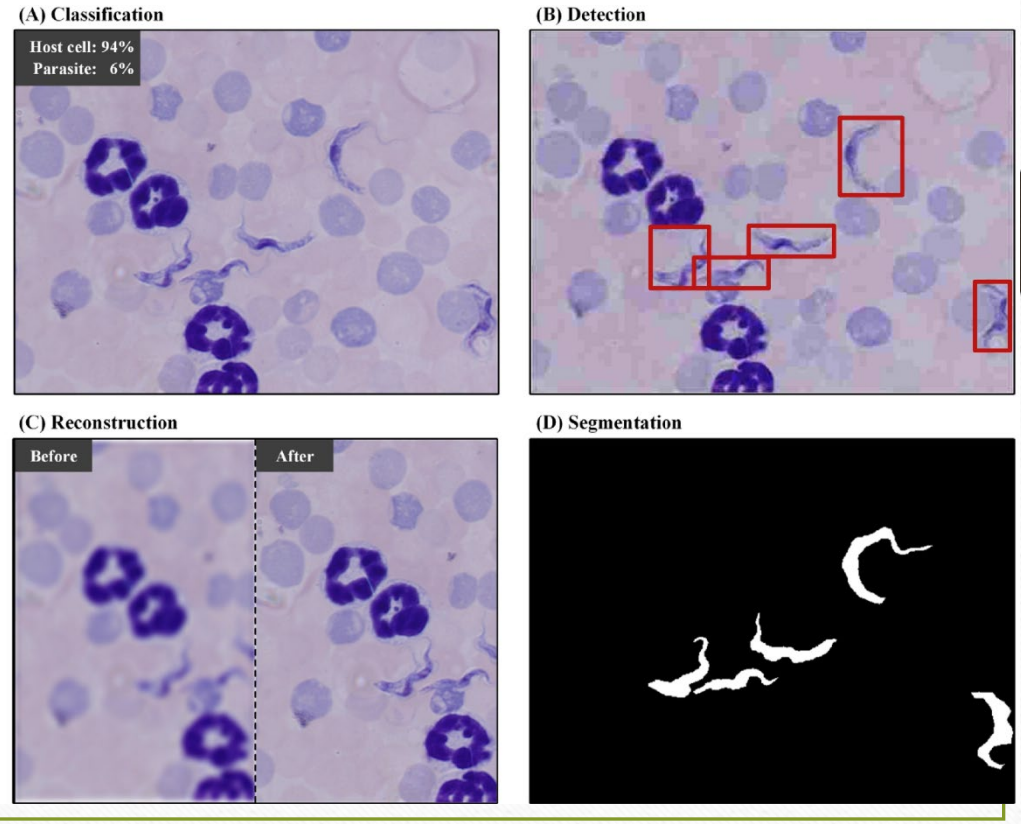
DL-based microscopy image analysis has been successfully applied in parasitology, including high-throughput parasite detection, quantitative analysis of host–pathogen interactions, and aberrated images correction.

Trends in Parasitology

CellPress

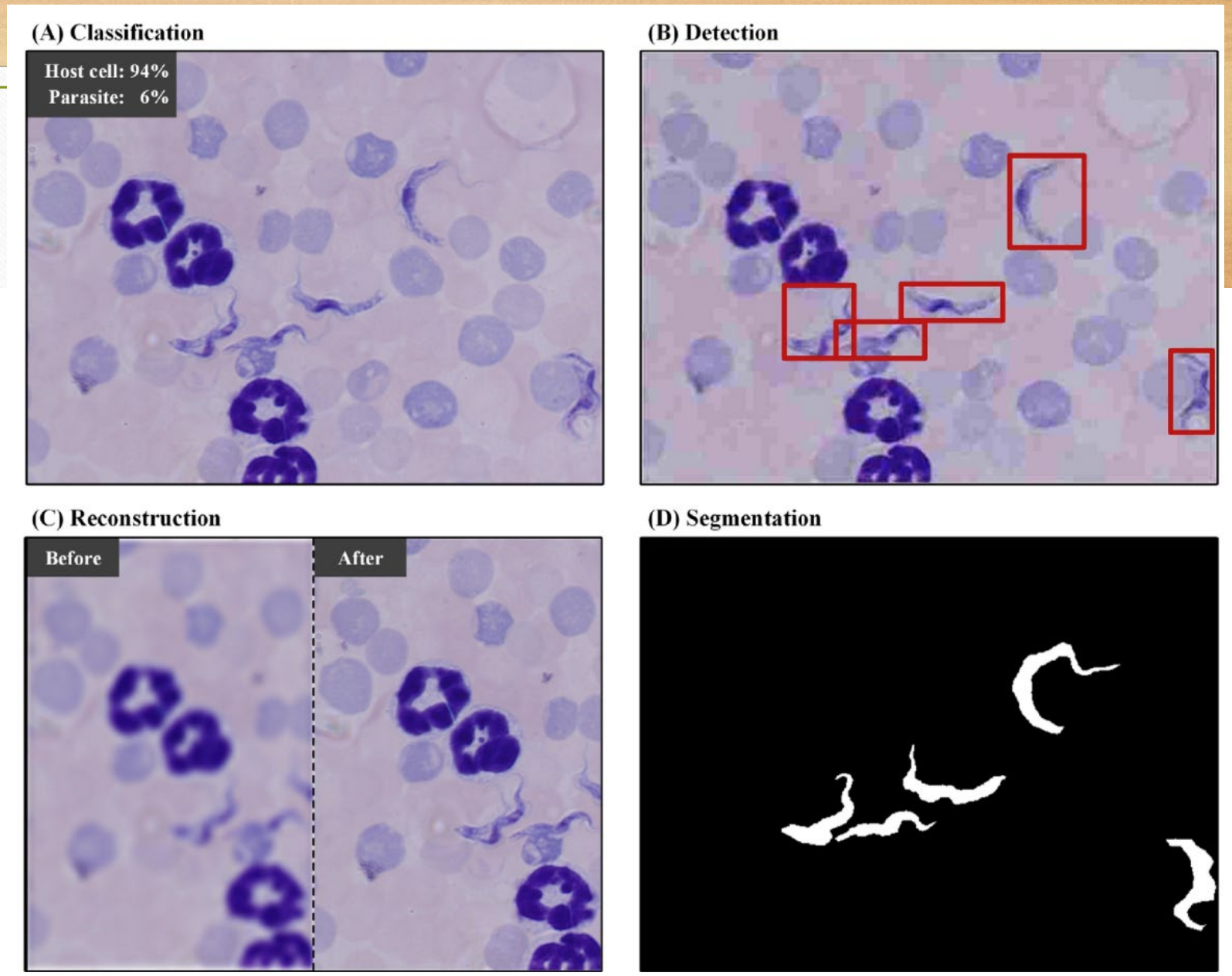
Review

AI-powered microscopy image analysis for parasitology: integrating human expertise



Trends in Parasitology 2024

- Classification
- Detection
- Reconstruction
- Segmentation



Trends in Parasitology 2024

Digital Screening for Parasites, MTB

How it works

4-step process:

Prepare slides

Lab techs prepare the slides using a fecal concentration device. The Apacor Mini or Midi

Scan slides

Technicians load slides into a supported scanner. The scanner scans the slide and produces a

Process images

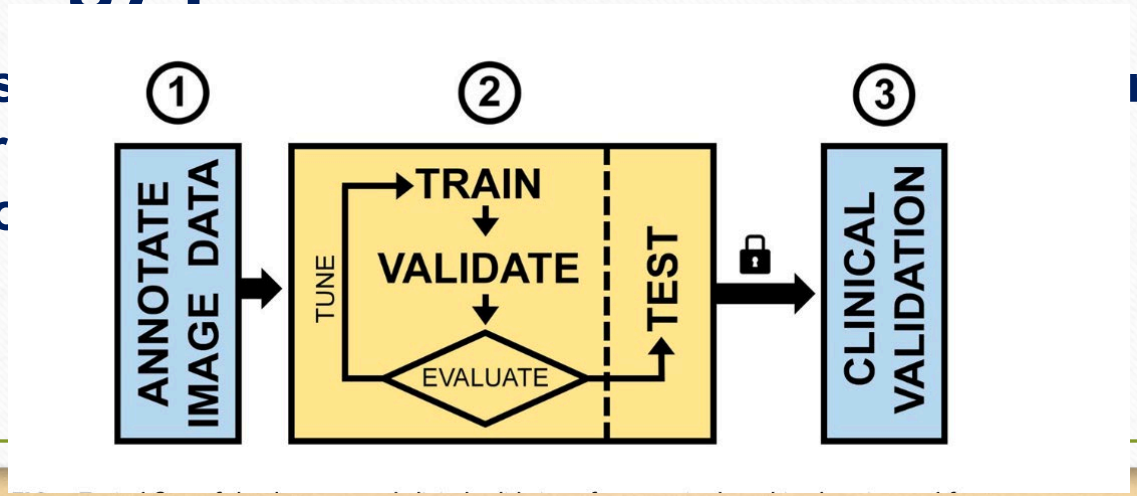
The AI algorithm uses a convolutional neural network to find ova, parasites, and other

Review results

Technologists log into Techcyte on a web browser and review the scanned images, confirming the

Image Analysis AI (IAAI) tools
Journal of Clinical Microbiology 2023: 61:1-9

- **These image analysis AI (IAAI) tools are beginning to penetrate routine clinical microbiology practice.**
- **image analysis … mages as input data (e.g., nutr … encompassing an entire micro …**



How can AI help in UHC ?

- Early Disease Detection
- Telemedicine Enhancement

Telemedicine Enhancement

AI can power telemedicine platforms, allowing patients in remote areas to consult with doctors virtually, providing access to specialist care without needing to travel long distances.

Low-cost "Telesimulation" training improves real patient pediatric shock outcomes in India

Quasi experimental interrupted time series : Pediatric Emergency team (doctors & nurses) was observed multiple times before pre(14 weeks),during (14 weeks) & after an intervention-post (11 weeks)

Time-critical tasks & hemodynamic parameters in the first hour management of real patient shock, CALM leadership score were collected by trained observers

INTERVENTION : TELESIMULATION with hotkeys based case scenarios

During Telesimulation
1st Vs 2nd sessions

40 Telesimulation sessions (2 scenarios/ team of 3-4 members)

76 participants (Doctors & nurses)

%Completion of tasks : 69% vs 93%
p <0.001
Median CALM score: 35.05 vs 39.4
p<0.001

During Real Patient Care of Shock in ER by Pediatriic Emergency Team (PET)

238 (72%) : Septic
64 (19%) :Hypovolemic
28 (8%) : Cardiogenic
2 (1%) :Anaphylactic

332 pediatric patients in shock

Pre : 88
INTERVEN: 131
Post : 113

MODS

34%(1), 31%(2), 20%(3) p<0.034

Improved First hour Hemodynamics 71% Pre, 79% INTERVEN, 87%Post
p<0.007

Time to resolution of shock
24 hours -Pre,
6 hrs -INTERVEN,
4.5 hrs- Post p<0.002

Median CALM score for leadership assessment
38 Pre, 38 Interven , 40 post p<0.05

Task completion as per checklist during first hour 87.5% (Pre), 100% (INTERVEN), 100%(Post)
p<0.05 Pre vs Post

- Telesimulation training using our low-cost "Hotkey" videos is feasible and improved the process of care, Team Leadership interventions in both simulated and real patients
- Improvement in hemodynamics at 1st hour and time to resolution of shock in real patients is encouraging

Telesimulation in Community health – Covid

- During the COVID-19 pandemic, in-person simulation had to be moved to a virtual platform and was found to be a very effective training environment.
- Telesimulation is still used to train community health and mental health nursing students at Texas A&M because many of them will go on to practice in a virtual environment.

How can AI help in UHC ?

- Early Disease Detection
- Telemedicine Enhancement
- Personalized Treatment Plans

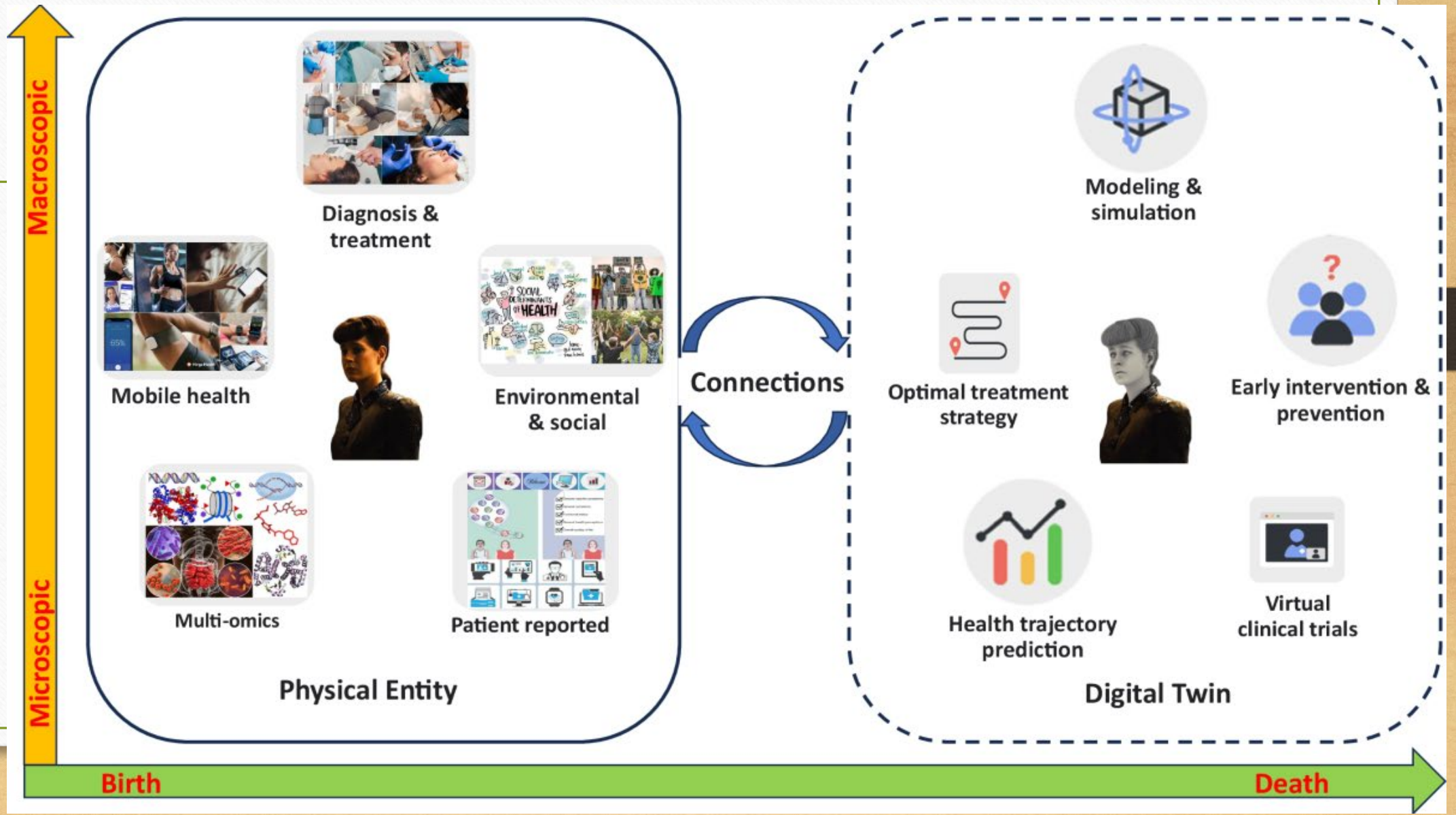
Personalized Treatment Plans:

- By analysing large patient datasets, AI can generate personalized treatment plans tailored to individual needs, considering medical history, genetic information, and lifestyle factor

Methods in AI Simulation

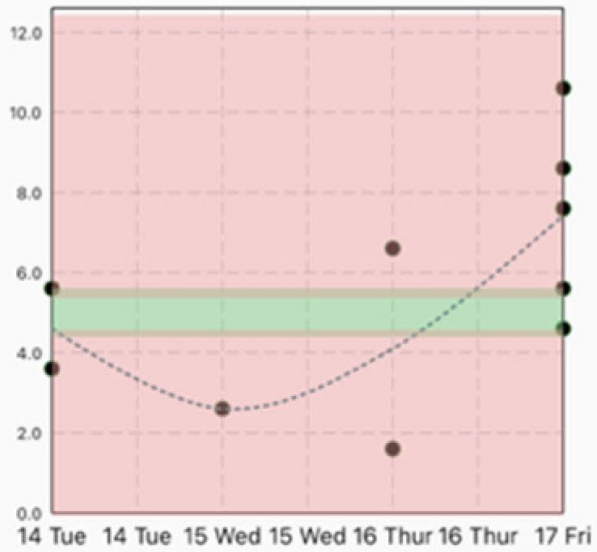
- **Digital Twin Simulation**
  - **Creates a digital replica of a physical asset, such as a machine, Human, to test performance in various scenarios with AI monitoring.**

DNA Nudge technology



1:26

Blood Glucose



You are doing great!

AVERAGE GLUCOSE	4.9 mmol/L
% above target	48%
% in target	13%
% below target	35%

Recently Added

17 Fri at 04:52 PM	5.6 mm
17 Fri at 03:07 PM	7.6 mmol/L

1:28

Salmon salad

Ingredients | Nutrition

Proximates: 951 g
Water: 255 g
Energy: 208 kcal
Protein: 203 g
Total lipid (fat): 204 g
Carbohydrates: 956 g
Carbohydrate, by difference: 205 g
Fiber, total dietary: 291 g
Sugars, total including NLEA: 269 g
Minerals: 300 mg
Calcium, Ca: 301 mg
Iron, Fe: 303 mg
Magnesium, Mg: 304 mg
Phosphorus, P: 305 mg
Potassium, K: 306 mg
Sodium, Na: 307 mg
Zinc, Zn: 309 mg
Copper, Cu: 312 mg

8:47

Medication

April 2022 | Month

Sun	Mon	Tue	Wed	Thu	Fri	Sat
24	25	26	27	28	29	30

Tablet
1 x 50mg
08:43 AM

8:48

Learn

What is diabetes?

Diabetes is a serious complex condition which can affect the entire body. Diabetes requires daily self care and if complications develop, diabetes can have a significant impact on quality of life and can reduce life expectancy. While there is currently no cure for diabetes, you can live an enjoyable life by learning about the condition and effectively managing it.

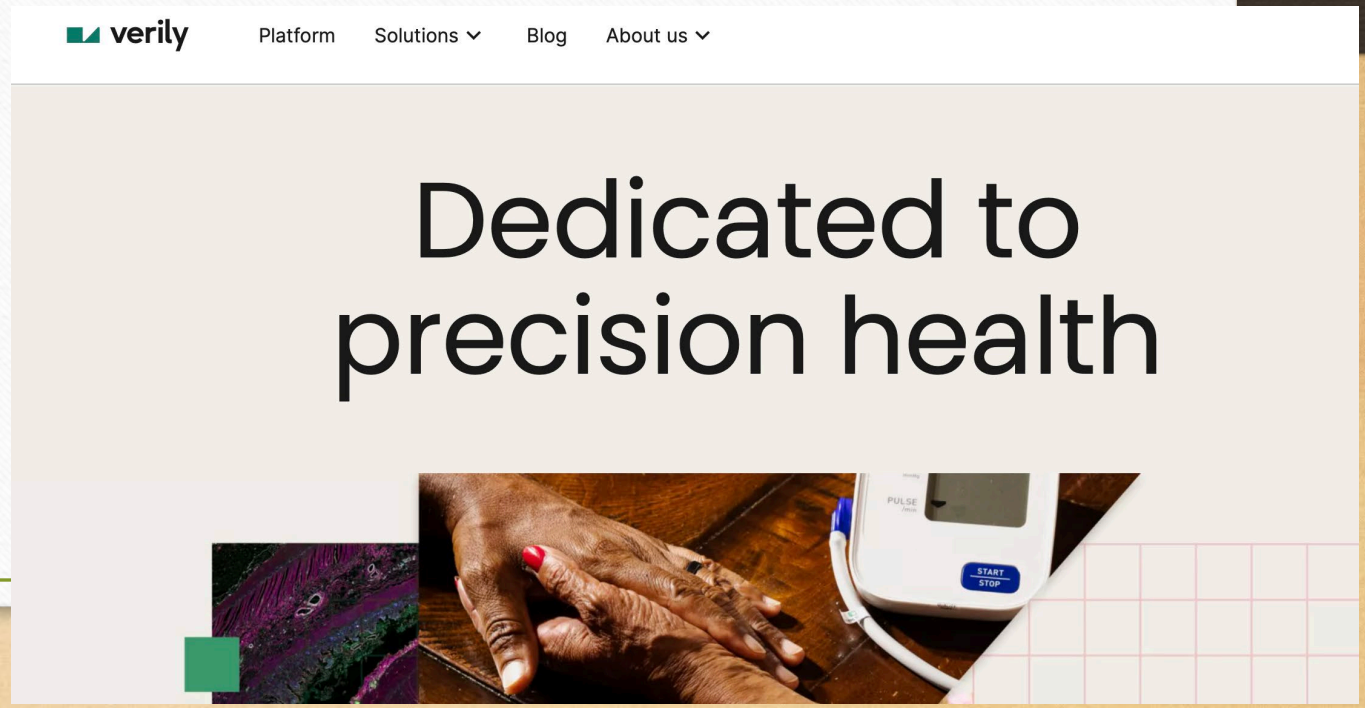
How diabetes affect the body?

AI NAMS conference
March 2024
Mumbai

Google AI and Aravind Eye care

A Madurai-based hospital and Google are working together to stop early blindness

Google is partnering with Madurai-based Aravind Eye Hospital on an AI-based algorithm to screen diabetic retinopathy and detect the early onset of blindness



How can AI help in UHC ?

- Early Disease Detection
- Telemedicine Enhancement
- Personalized Treatment Plans
- Predictive Analytics

Predictive Analytics

AI can predict potential health risks based on patient data, enabling preventive healthcare measures and early interventions.

Role of AI in predicting Monsoon Outbreaks

Journal of Safety Science and Resilience 5 (2024) 130–146

Science Press

Contents lists available at ScienceDirect

Journal of Safety Science and Resilience

journal homepage: www.keaipublishing.com/en/journals/journal-of-safety-science-and-resilience/

AI for science: Predicting infectious diseases

Alexis Pengfei Zhao [a], Shuangqi Li [b], Zhidong Cao [a,*], Paul Jen-Hwa Hu [c], Jiaojiao Wang [a], Yue Xiang [d], Da Xie [e], Xi Lu [f]

2024

© February 2022| IJIRT | Volume 8 Issue 9 | ISSN: 2349-6002

Prediction of Dengue Outbreaks in Mumbai Region Based on Disease Surveillance and Meteorological Factors using Big Data Approach

Asha Bharambe[1], Dhananjay Kalbande[2]

[1]*Department of Information Technology, Vivekanand Education Society's Institute of Technology, Mumbai, India*

[2]*Department of Computer Engineering, Sardar Patel Institute of Technology, Mumbai, India*

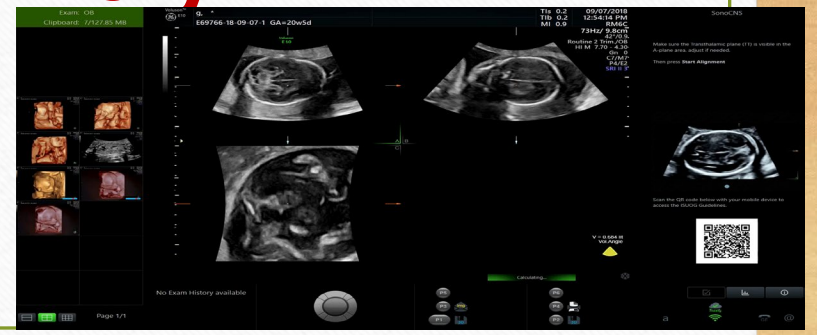
Big data analysis for forecasting and modelling epidemic outbreak.
Researcher: Bharambe, Asha Aniket. Guide(s):, Kalbande, Dhananjay R.

Artificial intelligence in obstetrics

Ki Hoon Ahn, MD, PhD[1], Kwang-Sig Lee, PhD[2]

Obstetrics & Gynecology Science

- **Predicting Pre term Birth.** **94% accuracy**
- **Estimated fetal weight** -gestational age at delivery, parity, 1-minute/5-minute Apgar scores, and newborn's gender.
- **Predicting Successful Vaginal Delivery**
- and many more



Obstet Gynecol Sci 2022;65(2):113-124

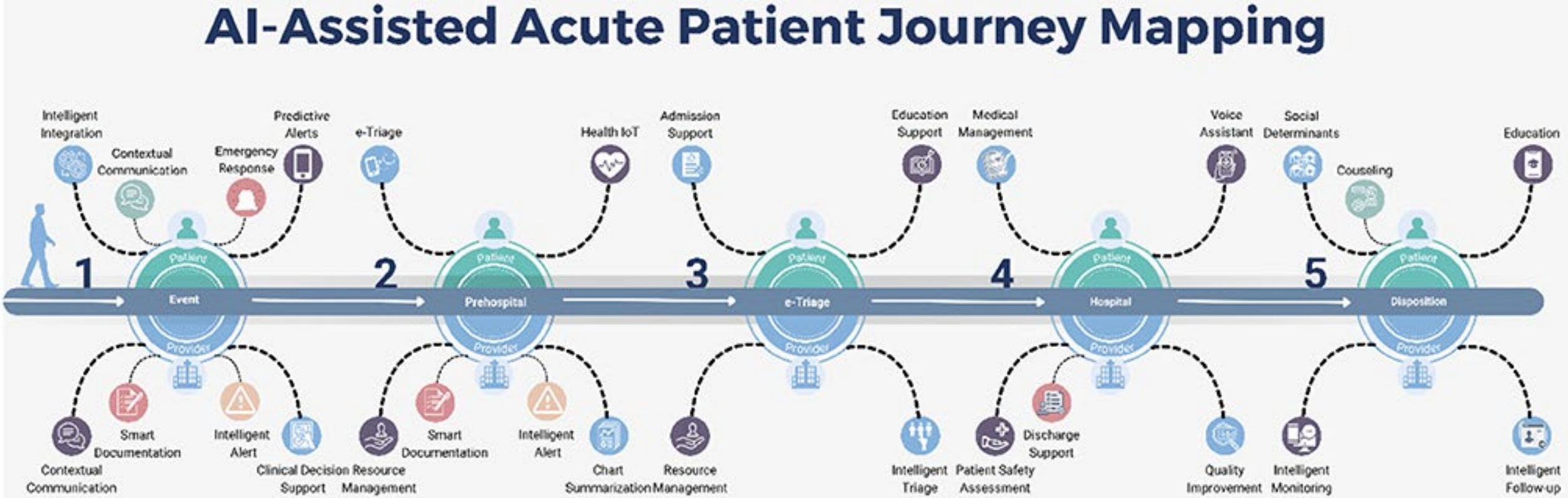
How can AI help in UHC ?

- Early Disease Detection
- Telemedicine Enhancement
- Personalized Treatment Plans
- Predictive Analytics
- Resource Optimization

Resource Optimization

AI algorithms can optimize hospital bed allocation, streamline appointment scheduling, and manage healthcare resource utilization efficiently.

Crowded Casualty



How can AI help in UHC ?

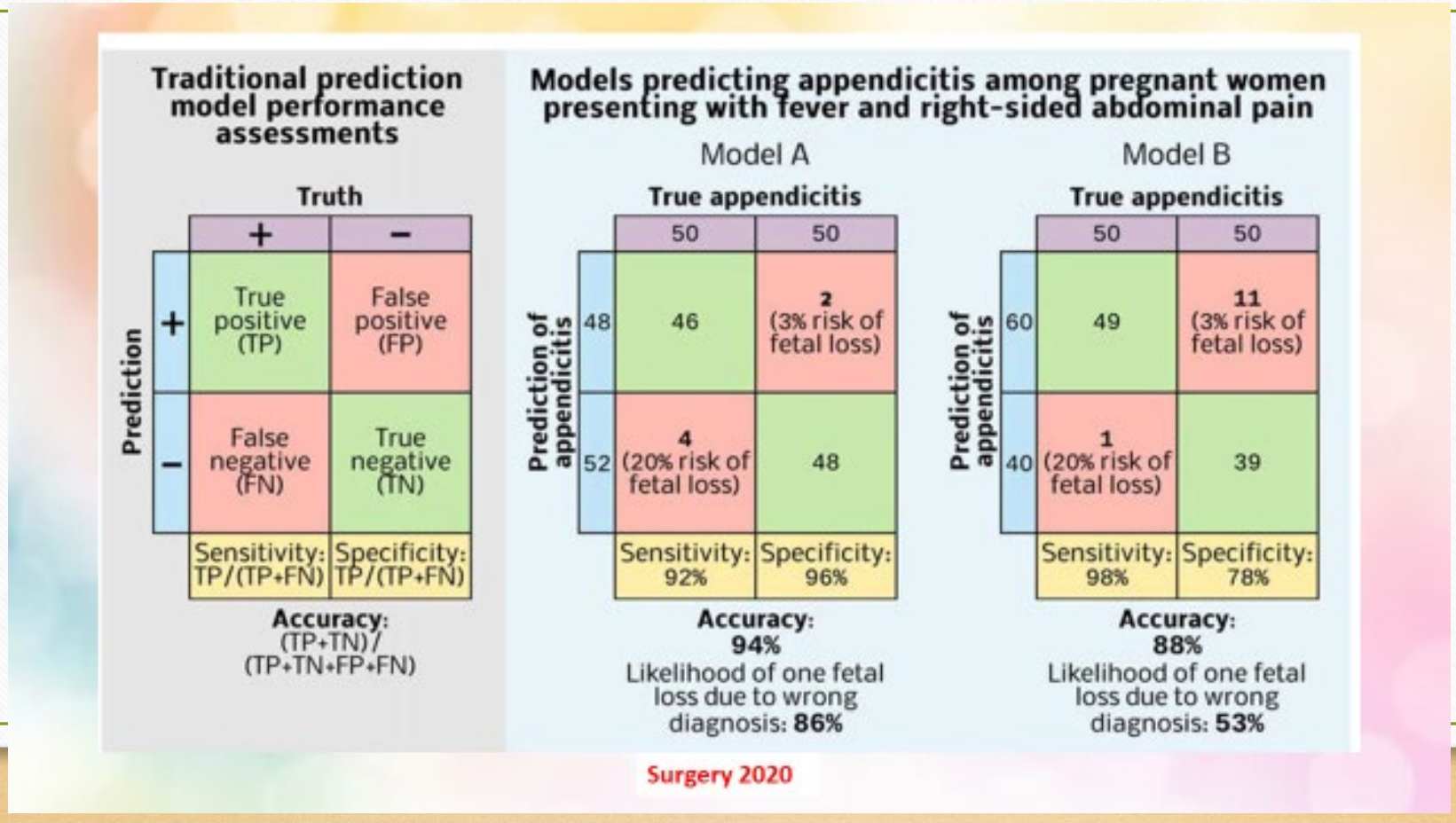
- Early Disease Detection
- Telemedicine Enhancement
- Personalized Treatment Plans
- Predictive Analytics
- Resource Optimization
- Clinical Decision Support Systems

Clinical Decision Support Systems:

- AI-powered decision support systems can assist doctors in making informed diagnosis and treatment decisions by providing real-time insights based on patient data and clinical guidelines

Data Driven Simulation

- AI processes historical data to generate accurate simulation outcomes.



How can AI help in UHC ?

- Early Disease Detection
- Telemedicine Enhancement
- Personalized Treatment Plans
- Predictive Analytics and Disease control
- Resource Optimization
- Clinical Decision Support Systems
- Drug Discovery and Development

- **Drug Discovery**

Virtual screening for potential anti parasitic compounds

Molecular docking to predict drug-target interactions

Tailored treatment strategy based on Individual patient data

AI driven drug discovery for novel compounds and repurposed drugs.

pharmaceuticals

MDPI

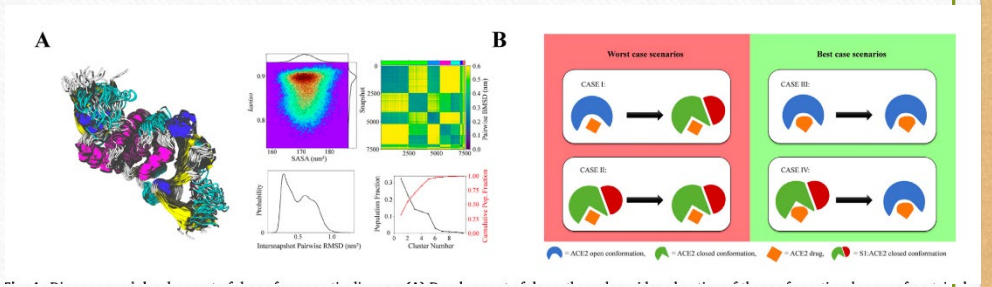
Perspective

Artificial Intelligence, Machine Learning, and Big Data for Ebola Virus Drug Discovery

Samuel K. Kwofie [1,2,*], Joseph Adams [3], Emmanuel Broni [1,3,4], Kweku S. Enninful [3,5], Clement Agoni [6,7], Mahmoud E. S. Soliman [6] and Michael D. Wilson [3,4]

AI in Parasitology Trends

- Drug Target Discovery
  - Host-Parasite Interactions.
  - Metabolic Pathways
  - Virulence Factors
  - Global Collaboration



Worst case Scenario
Best case Scenario

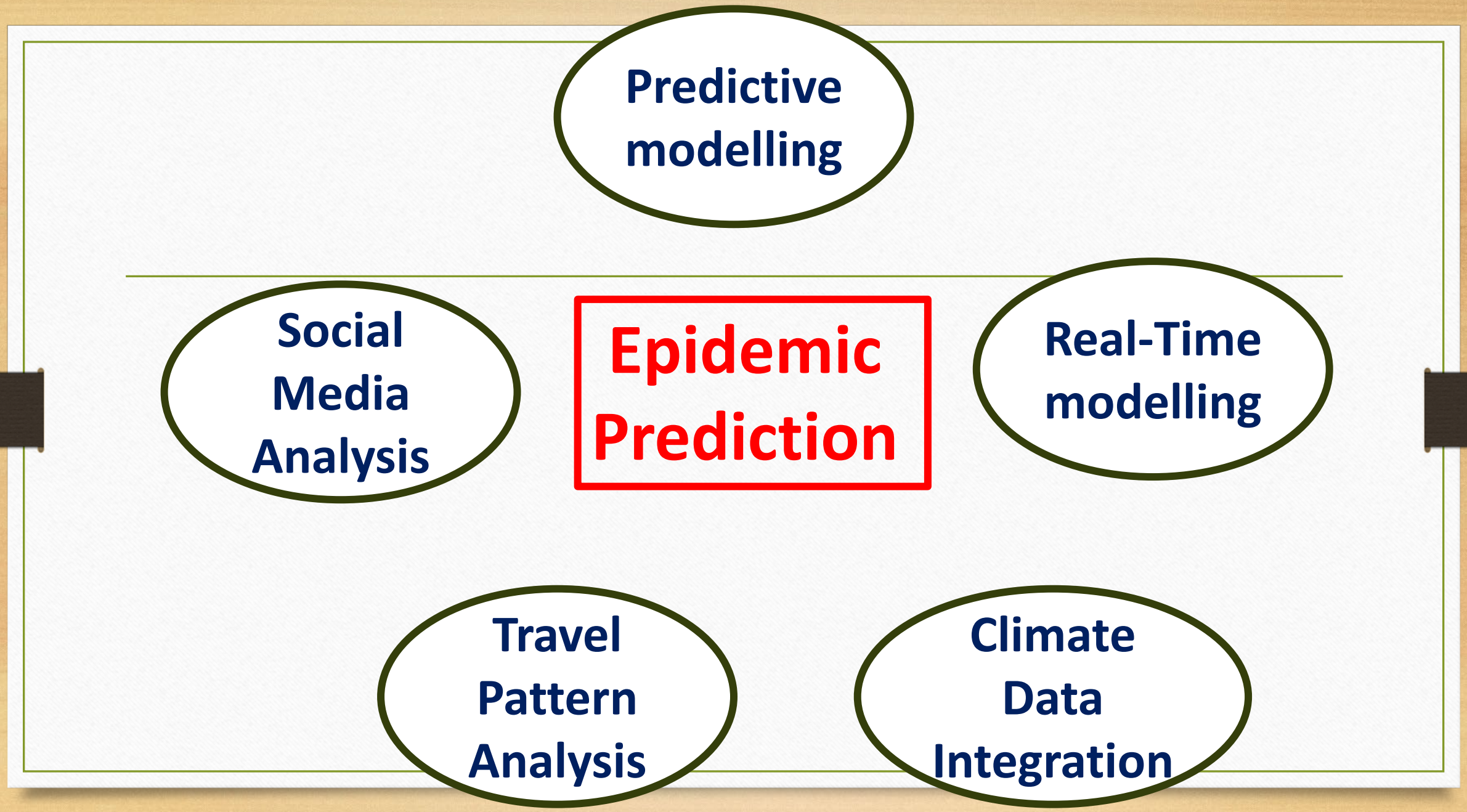
Mesamalaria.Org

mesamalaria.org

https://mesamalaria.org › mesa-track › artificial-intellige...

Artificial Intelligence-based drug resistance screening of ...

To validate 'Read Until' as an **artificial intelligence** (**AI**)-based method to conduct **drug** 8 **resistance** profiling of malaria **parasites** using genomic DNA from ...


Predictive modelling
Social Media Analysis
Epidemic Prediction
Real-Time modelling
Travel Pattern Analysis
Climate Data Integration

AI and Dengue Outbreak Prediction Tropical Medicine and Infections

Tropical Medicine and Infectious Disease

MDPI

Article

Application of Artificial Neural Networks for Dengue Fever Outbreak Predictions in the Northwest Coast of Yucatan, Mexico and San Juan, Puerto Rico

Abdiel E. Laureano-Rosario [1,*], Andrew P. Duncan [2], Pablo A. Mendez-Lazaro [3], Julian E. Garcia-Rejon [4], Salvador Gomez-Carro [5], Jose Farfan-Ale [4], Dragan A. Savic [2] and Frank E. Muller-Karger [1]

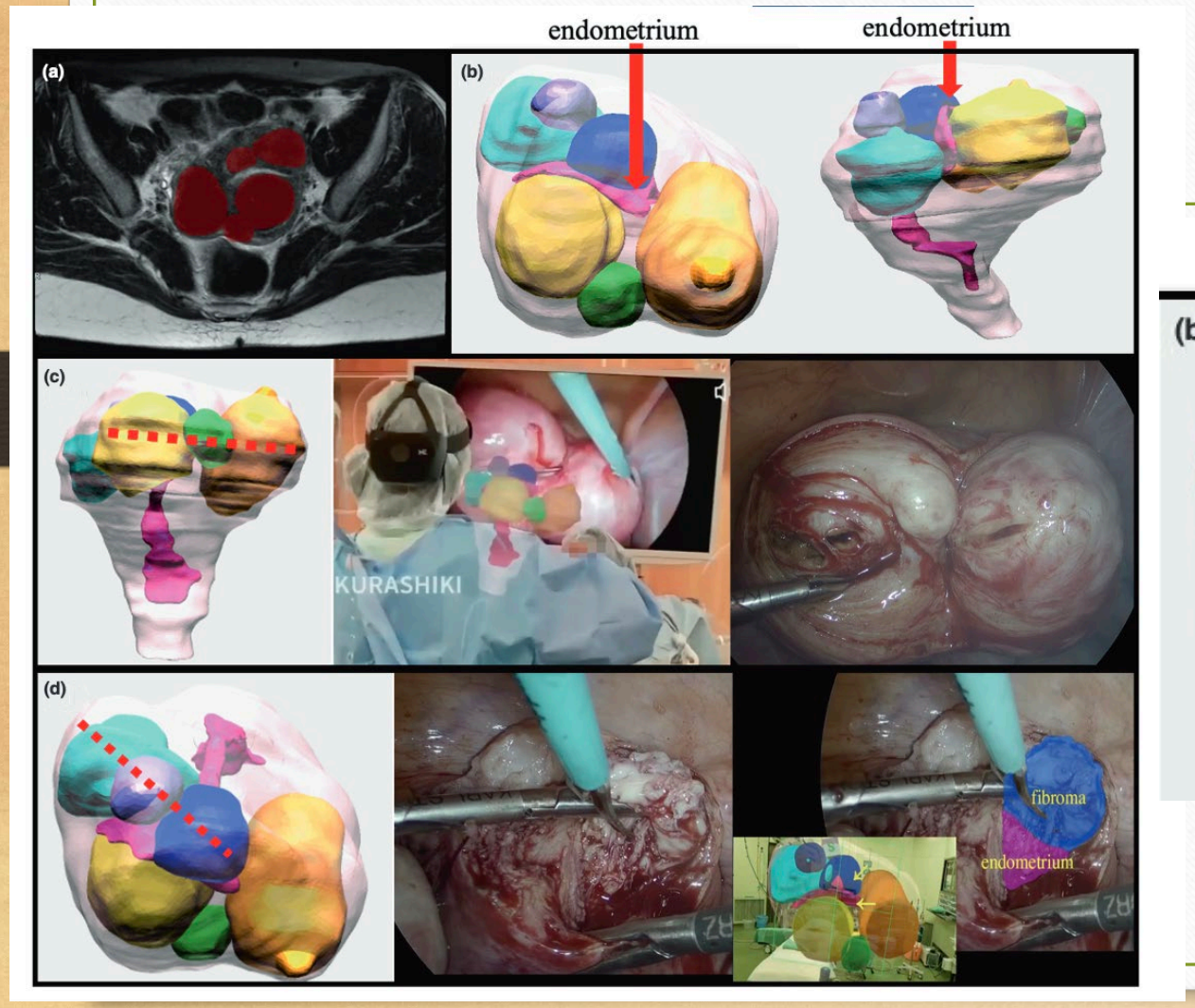
Large data analysis helps in predicting Dengue cases in Caribbean and Mexico

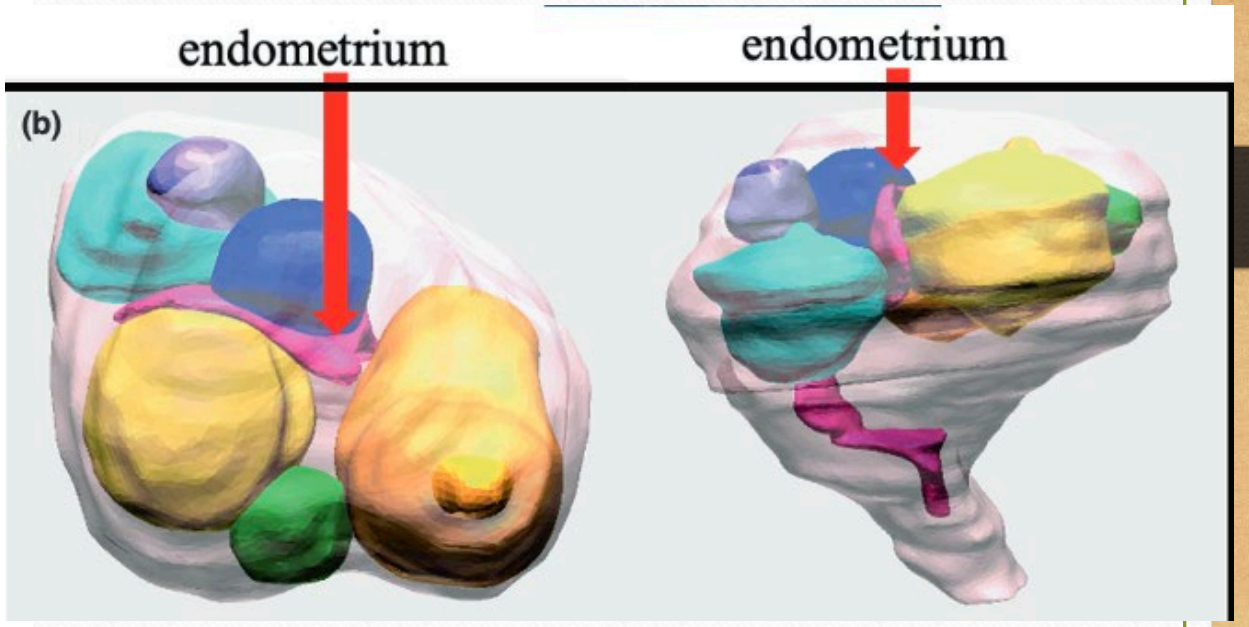
AI In Health Care Education

- **Hybrid Simulation**
  - **Combines AI with traditional simulation techniques for scenarios needing both real-world physics and predictive modeling.**


Mixed Reality
Any environment where the real and virtual objects are combined within a single display
Real Environment
Consists solely of real or physical objects
Augmented Reality
The real world is augmented with digital elements
Augmented Virtuality
The virtual world is augmented with real or physical objects
Virtual Environment
Consists solely of real or digital objects

Mixed Reality in Lap Myomectomy





364 | WILEY

Received: 3 December 2022 | Revised: 17 January 2023 | Accepted: 13 March 2023 | Published online: 25 March 2023

DOI: 10.1002/jga.14765

Gynecology

Clinical use of mixed reality for laparoscopic myomectomy

Yoshifumi Ochi | Shiori Yanai | Yasunori Yoshino | Mari Sawada | Shintaro Sakate | Kiyoshi Kanno | Masaaki Andou

Kurashiki Medical Center, Okayama, Japan

Correspondence
Yoshifumi Ochi, Department of Gynecology, Kurashiki Medical Center, 250 Bakuro-chou, Kurashiki, Okayama 710-8522, Japan.
Email: quartreporte.1012@gmail.com

Keywords: gynecologic surgery, laparoscopy, leiomyoma removal, mixed reality, myoma remnants, virtual reality

Intra-Operative Image Guidan

Using AI for Communication Skills

t al.

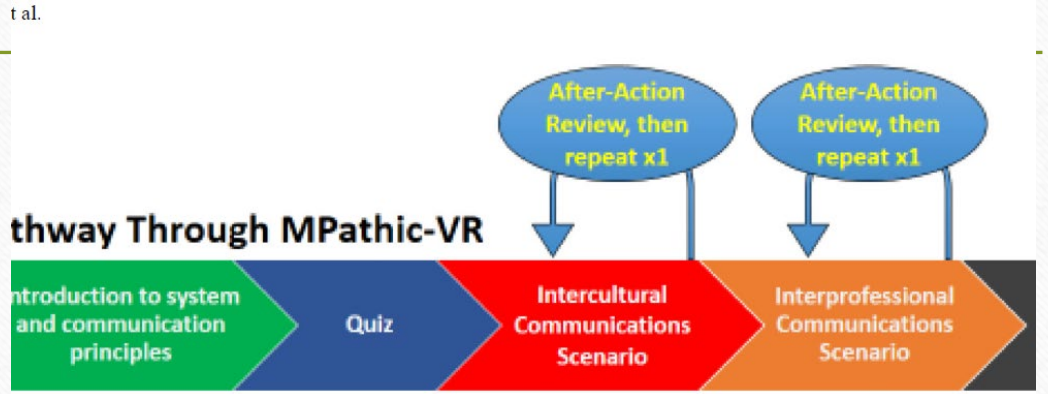
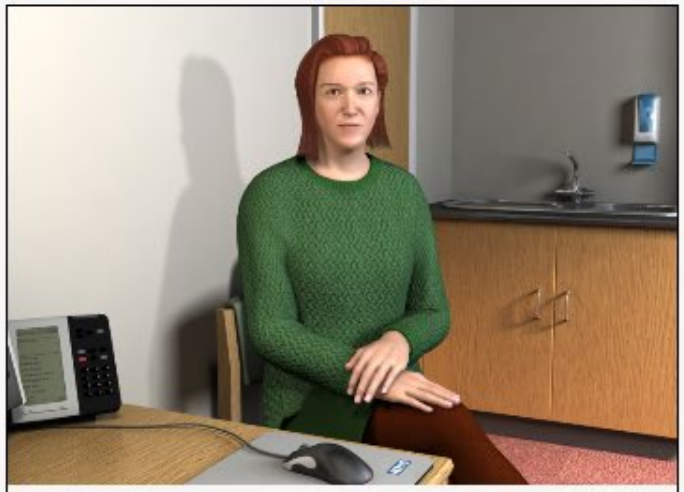


Figure 2.
Experience flow through the MPathic-VR computer simulation and the Computer-Ba
Learning control

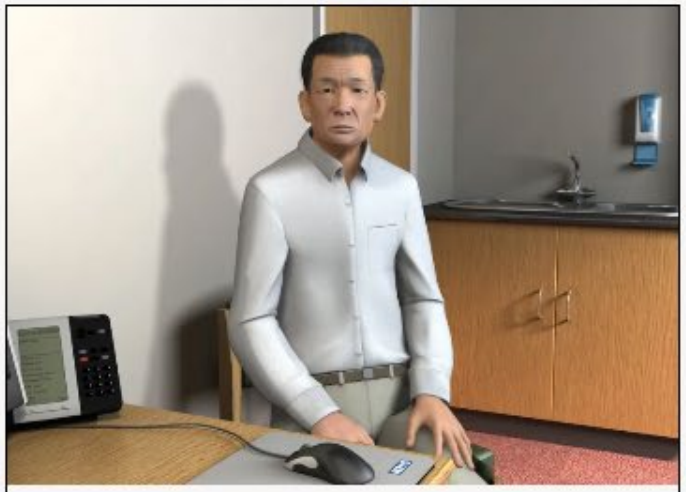
Avatar Virtual Patients

PCI Virtual Patient Scenarios



Stopping an Anti-depressant

Sharon has a review appointment booked in with her GP in 2 weeks time, and she has some concerns about this appointment that she would like to discuss with someone. You have not met Sharon before but have been asked to discuss her concerns. You have introduced yourself to Sharon, confirmed her identity and have established she prefers to be called



Suspected Bowel Cancer Consultation

This is exercise one of three, of a consultation with Takuma Hayashi. In this consultation you will conduct the initial stages of a consultation, including establishing what they would like to talk about.

Osteoarthritis Consultation

You recently met Celia in a consultation two weeks prior to today. In the previous consultation, you had a discussion with Celia to see how she was managing with her arthritis and she took a decision aid away with her to think about her options. This appointment today is to explore the options and discuss what Celia wants to do.

Type 2 Diabetes

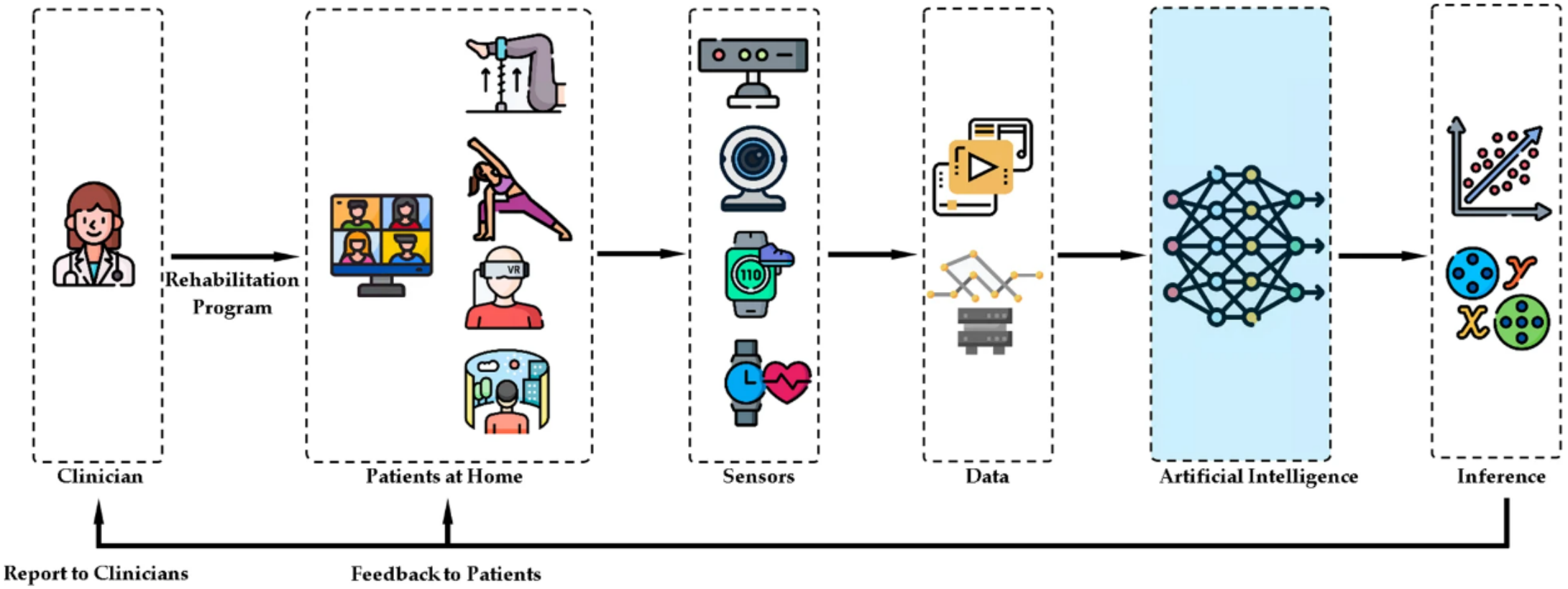
You are meeting with Shanvi Desai for the first time following her diagnosis with Type 2 Diabetes and since her GP prescribed Metformin. You have not met Mrs. Desai previously, but she has attended this practice before. You have already covered clinical areas including medication, blood sugar and blood tests, and are now entering a discussion about

Remote Consultation

You have not met or spoken to Stephen or Elijah before this consultation. Stephen phoned the surgery this morning to try and get an appointment for Elijah who is complaining of a sore throat. The receptionist informed Stephen that somebody from the surgery would give him a call back this morning.

Digital Medicine 2024 – (Nature)
AI driven Rehab – Hybrid Models

From: Artificial intelligence-driven virtual rehabilitation for people living in the community: A scoping review



mentice

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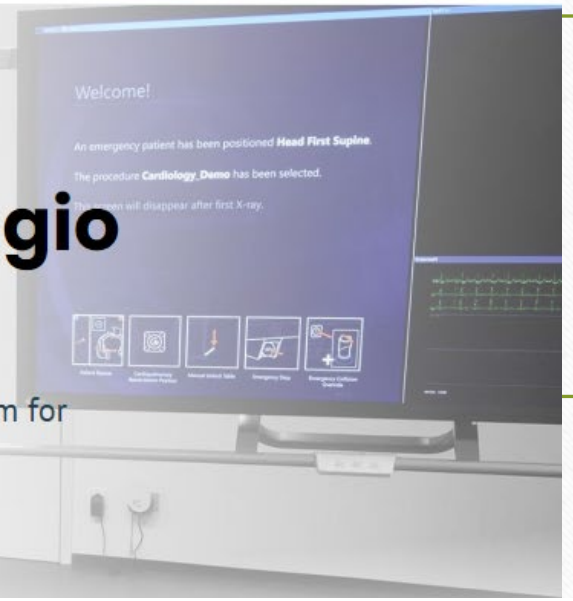
VIST® Virtual Patient

A Virtual Patient for your Angio suite

Convert your angio suite into a team training & skills acquisition platform for Image Guided Interventions

PHILIPS VASCULAR PATIENT | SIEMENS HEALTHINEERS VASCULAR PATIENT



mentice

PRODUCT SHEET - SOFTWARE

VASCULAR PATIENT LINK PHILIPS

INSTANTLY CONVERT YOUR ANGIO-LAB INTO A SKILLS ACQUISITION PLATFORM

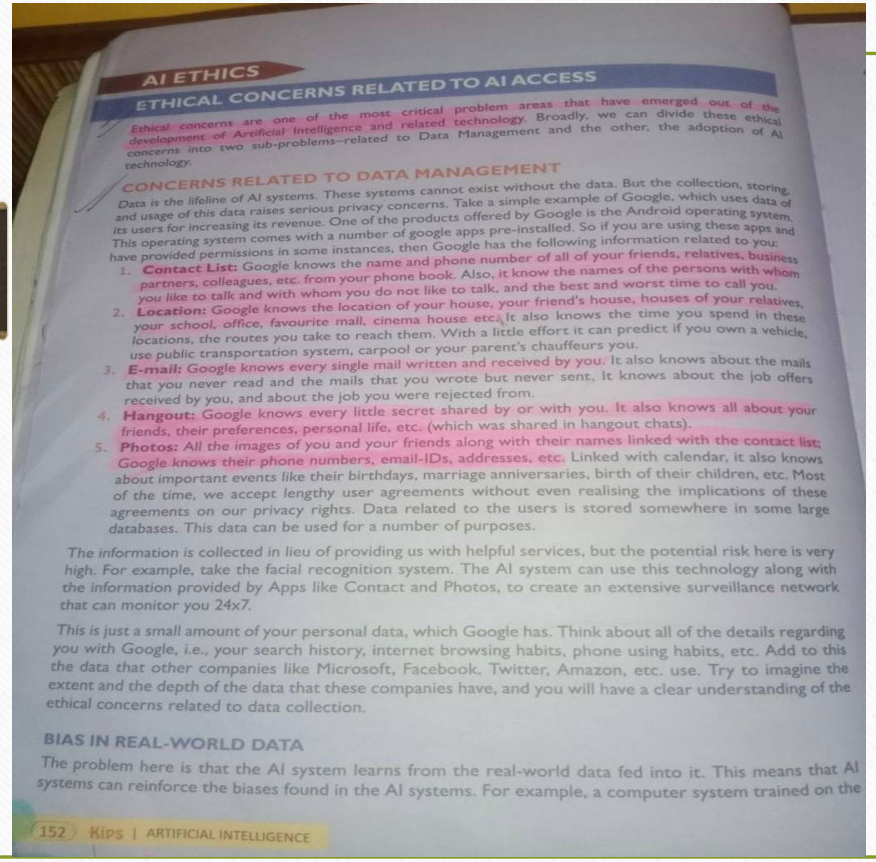
Vascular Patient Link is a Mentice software solution that is deployed on the VIST® G5 Virtual Patient simulator to connect the simulator to the Philips Angio-Suite system.

This connectivity is made possible by using the Philips communications protocol embedded into the

Concerns with AI

- Data Privacy Concerns
- Infrastructure Requirements
- Healthcare Professional Training
- Ethical Considerations

School classes and AI ethics



AI ETHICS

ETHICAL CONCERNS RELATED TO AI ACCESS

Ethical concerns are one of the most critical problem areas that have emerged out of the development of Artificial Intelligence and related technology. Broadly, we can divide these ethical concerns into two sub-problems–related to Data Management and the other, the adoption of AI technology.

CONCERNS RELATED TO DATA MANAGEMENT

Data is the lifeline of AI systems. These systems cannot exist without the data. But the collection, storing, and usage of this data raises serious privacy concerns. Take a simple example of Google, which uses data of its users for increasing its revenue. One of the products offered by Google is the Android operating system. This operating system comes with a number of google apps pre-installed. So if you are using these apps and have provided permissions in some instances, then Google has the following information related to you:

1. **Contact List:** Google knows the name and phone number of all of your friends, relatives, business partners, colleagues, etc. from your phone book. Also, it know the names of the persons with whom you like to talk and with whom you do not like to talk, and the best and worst time to call you.
2. **Location:** Google knows the location of your house, your friend's house, houses of your relatives, your school, office, favourite mall, cinema house etc. It also knows the time you spend in these locations, the routes you take to reach them. With a little effort it can predict if you own a vehicle, use public transportation system, carpool or your parent's chauffeurs you.
3. **E-mail:** Google knows every single mail written and received by you. It also knows about the mails that you never read and the mails that you wrote but never sent. It knows about the job offers received by you, and about the job you were rejected from.
4. **Hangout:** Google knows every little secret shared by or with you. It also knows all about your friends, their preferences, personal life, etc. (which was shared in hangout chats).
5. **Photos:** All the images of you and your friends along with their names linked with the contact list; Google knows their phone numbers, email-IDs, addresses, etc. Linked with calendar, it also knows about important events like their birthdays, marriage anniversaries, birth of their children, etc. Most of the time, we accept lengthy user agreements without even realising the implications of these agreements on our privacy rights. Data related to the users is stored somewhere in some large databases. This data can be used for a number of purposes.

The information is collected in lieu of providing us with helpful services, but the potential risk here is very high. For example, take the facial recognition system. The AI system can use this technology along with the information provided by Apps like Contact and Photos, to create an extensive surveillance network that can monitor you 24x7.

This is just a small amount of your personal data, which Google has. Think about all of the details regarding you with Google, i.e., your search history, internet browsing habits, phone using habits, etc. Add to this the data that other companies like Microsoft, Facebook, Twitter, Amazon, etc. use. Try to imagine the extent and the depth of the data that these companies have, and you will have a clear understanding of the ethical concerns related to data collection.

BIAS IN REAL-WORLD DATA

The problem here is that the AI system learns from the real-world data fed into it. This means that AI systems can reinforce the biases found in the AI systems. For example, a computer system trained on the

Introduction to AI ethics Class 9

As we are human beings and we are following some moral principles fo activities as well as to make our life comfortable with good manners an

These concerns and principles related to good manners, good behavior

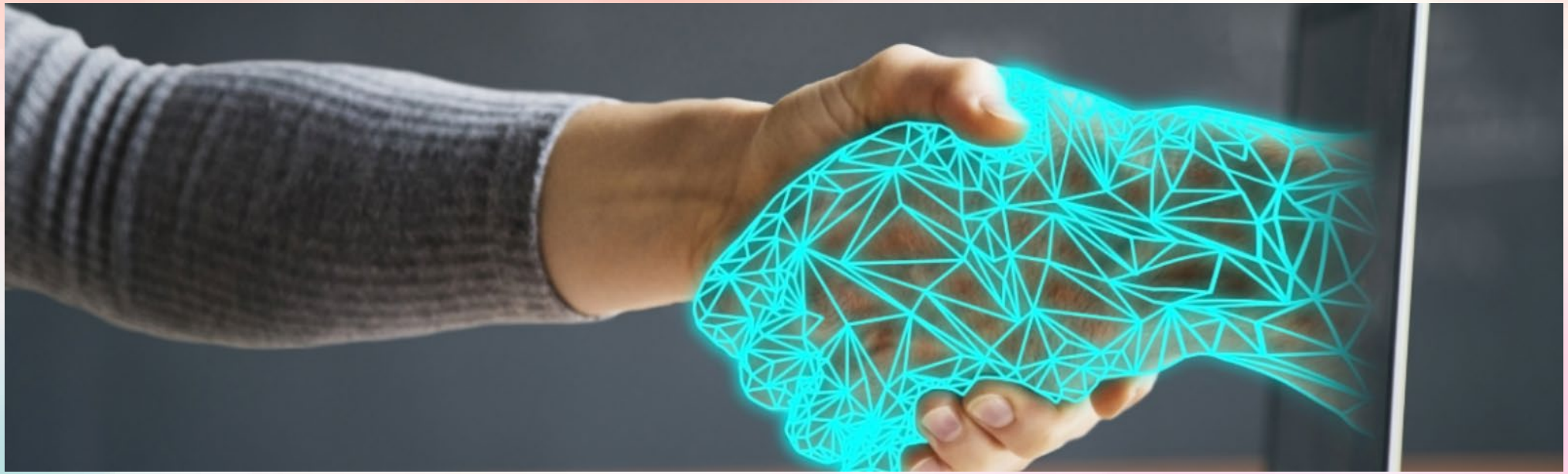
Similarly certain ethics are also associated with AI systems and tools. T known as AI ethics. So finally AI ethics can be defined as following:

AI ethics refers to the basic principles of AI system design that use the and produces the results.

Conclusion

- AI has potential to influence health care coverage through early diagnosis, improving reach of govt schemes, epidemiological prediction and disease control, personalized treatment and resource optimization.
- One must utilize AI consciously to augment health service

Embrace technology while staying Humane



Thank you and have a great time !