

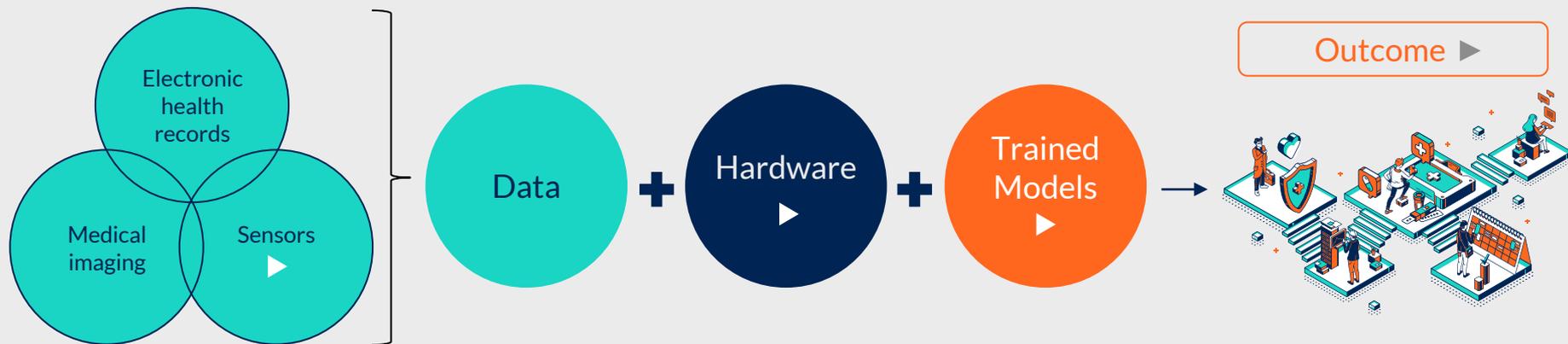
Artificial Intelligence (AI) in Healthcare

AI has revolutionised industries ranging from finance to logistics, where it is being used to make credit decisions and manage warehouses. Even the traditionally “high human touch” healthcare industry has begun to integrate AI solutions, using them to augment human intelligence and decision making. Here, we share how AI is already being used in the healthcare industry and what are the trends for the future.



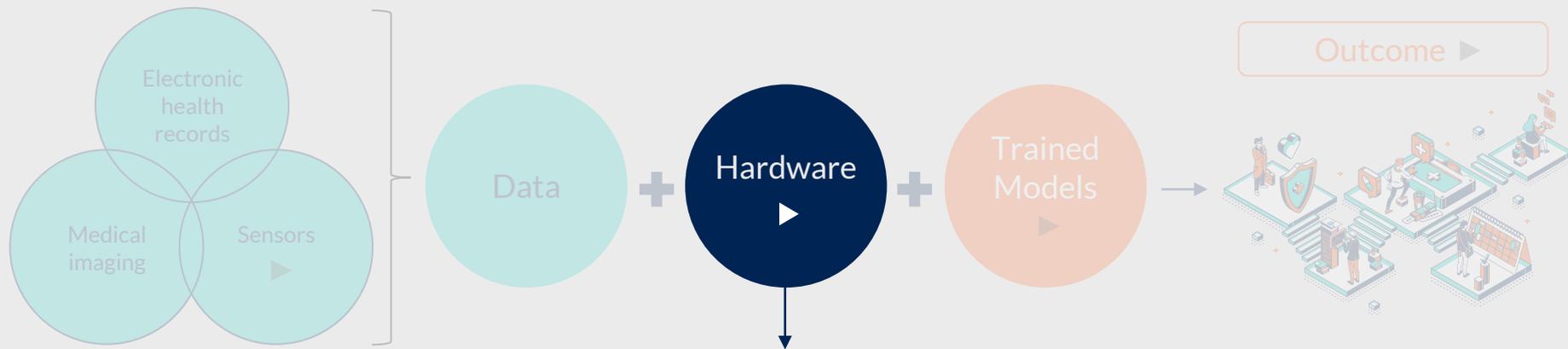
The Promise of AI in Healthcare

AI is making an impact at every stage of the patient journey. Here's how:



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Performance Efficiency

Central processing unit (CPU) is designed for use in general purpose processing and applications.

Graphics processing unit (GPU) is designed to have similar mathematical basis of neural networks and image manipulation, i.e., involving matrices.

Field-Programmable Gate Arrays (FPGA) is formed by internal hardware blocks with user-programmable interconnects. Therefore, users can customise operations for a specific application.

Application-Specific Integrated Circuit (ASIC) is designed to have custom integrated circuit optimised for a particular application, which can help to accelerate calculation and increase throughput of computation.

Flexibility



AI Hardware

Faster and dedicated hardware: here are some cutting-edge hardware designed to improve AI processing and keep up with rapid AI advancements.

Xilinx FPGA/ ACAP

To accelerate processing and match the speed of AI innovation, Xilinx offers a host of multi-node devices customisable at both hardware and software levels for various applications and workloads.

Graphcore IPU

From training to industry, Graphcore designs flexible and easy-to-use accelerators for AI and machine learning at all levels.

Neural Network Accelerator for IoT Edge Processing

This small, secure, low power and cost-effective hardware module supports multiple pre-trained AI models, allowing for edge processing at the IoT sensor node itself and reducing the need for high bandwidth communications to the cloud.

AIChip

AIChip Technologies provides application-specific integrated circuit (ASIC) solutions from customer design to manufacturing. Their low-power designs allows users to achieve long battery life and high-power efficiency.



AI Sensors

Before providing answers or suggestions, AI devices collect data to analyse. This is done through sensors that gather information about a patient's body straight from the source. AI sensors are grouped broadly into the following three categories:

Wearable sensors

- Conveniently and non-invasively attached (e.g., watches, clothing, bandages, glasses, contact lenses and rings)
- Sensor inputs for monitoring or measurement purposes

Implantable sensors

- Small enough to be inserted into the body
- Biocompatible

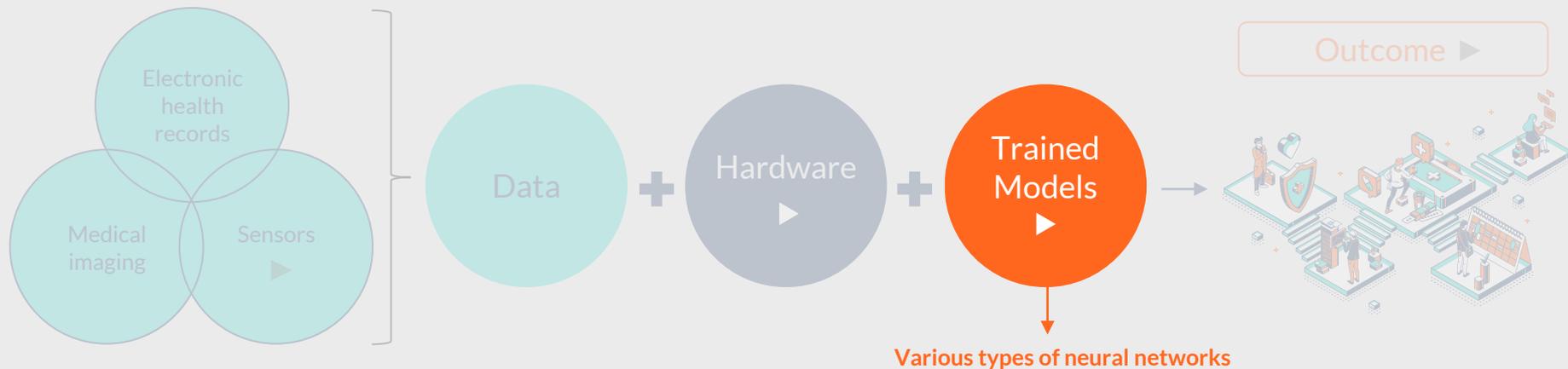
Ingestible sensors

- Designed to be swallowed and pass through the lumen of the digestive tract and reach organs around the abdomen
- For monitoring the chemical process in stomach, mechanical movements of the gastrointestinal tract and electrical stimuli of the muscle contractions



The Promise of AI in Healthcare

AI is making an impact at every stage of the patient journey. Here's how:



Reinforcement Learning
Through trial and error, reinforcement learning builds previous trends into algorithms

Convolutional Neural Networks (CNNs)
CNNs excel at extracting abstract patterns (e.g. computer vision)

Recurrent Neural Networks (RNNs)
RNNs make predictions based on longitudinal or time series data (e.g. natural language processing)

Generative Adversarial Networks (GANs)
Pitting neural networks against each other to generate data (e.g. improving image recognition)



Applications of AI in Healthcare – A Patient's Journey

01 Preventive Healthcare^{1a,b}

Various complementary models are used for personalising an individual's wellness regime as well as a patient's optimal sequence of adaptive intervention or treatment decisions.

02 Analysis^{2a,b,c}

CNNs help in training and analysing oncology and pathology data for automated diagnosis.

03 Treatments^{3a,b,c}

GAN models with reinforcement learning can help in the *de novo* design of new drugs, whereas CNN and RNN models can help analyse compound properties to predict their activity and synthesis.

04 Patient Experience^{4a,b}

Reinforcement learning and RNN learn from past data and trends to improve future allocation and scheduling of health resources.

05 Assistive Technologies^{5a,b,c}

Devices and apps built to aid patients in daily tasks like reading, speaking, navigating spaces and picking up objects.



01

AI for Preventive Healthcare

By monitoring patients and managing early symptoms, these tech offers allow users to be more proactive in identifying potential health issues and taking action to prevent them from happening.

Beta Bionics

This fully integrated medical device is designed to reduce the burden and cost of diabetes care by automatically and autonomously managing blood sugar levels 24/7 in people with type 1 diabetes (T1D).

Battery-free Wireless Body Sensor Networks

This near-field enabled clothing is able to establish wireless power and data connectivity between multiple distant points (up to meter scale) on the body to create a network of battery-free sensors interconnected by proximity to functional textile patterns.

Caretaker Medical

This patient monitoring device uses a simple finger cuff to measure continuous beat-by-beat blood pressure, heart rate, and other physiological parameters.

Starkey Livo AI

Livo AI is the world's first Healthable hearing aid that uses integrated sensors and artificial intelligence to enhance user's listening experience and access to information clearly.

Wireless e-Textiles

By confining radio-waves onto conductive textiles, wireless signals can propagate along the surface of the textile and provide efficient and secure transmission of wireless signals on potential athletic or medical clothing.



01

AI for Preventive Healthcare



Wireless Muscle Blood Flow Monitor in Low Back Pain Population

This non-invasive tech offer is capable of measuring muscle oxygenation, allowing early detection of lower oxygenation levels that could potentially lead to lower back pain.

ECG Sensing Solution

Suitable for wrist-worn wearables and clothing, this tech offer is able to measure health performance metrics with electrode-based sensors, chipset and related software analytics. It is capable of analysing parameters like heart rate variability and stress levels.

Continuous Blood Pressure Monitoring

This wearable blood pressure monitor, consisting of several chest-based sensors, is capable of continuous, non-invasive blood pressure and vital signs monitoring.

Non-invasive Intracranial Pressure (ICP Monitor)

To prevent lasting damage from a head injury, this low-cost non-invasive tech offer uses a forehead mounted probe to monitor intracranial pressure and facilitate treatment.

Vital Signs Monitoring

This is the world's smallest 60GHz compact radar. Capable of detecting the respiration rate and heart of people from a distance, the device can be used in hospitals, elderly care centres, prisons or even vehicles to count people or monitor vital signs.



02

AI for Analysis

From sensors to imaging platforms, these technologies help collect and make sense of a patient's health data for better treatment.

HiCura's uSINE

With ultrasound imaging and AI, HiCura's uSINE is able to identify the precise location for spinal anaesthesia insertion—resulting in fewer insertion attempts and reducing potential pain and complications.

Arterys

Harnessing cloud computing and deep learning AI, Arterys provides physicians and radiologists with real-time 4D Flow images for better diagnosis and more accurate treatment decisions.

Lunit

Lunit develops deep learning and 3D visualisation software to help physicians with difficult-to-diagnose diseases. Their products include software for chest x-ray analysis, mammography analysis and immuno-oncology tissue phenomics.

See-Mode's Augmented Vascular Analysis (AVA)

This technology uses deep learning to analyse each image in a vascular ultrasound scan and produce accurate reports in under a minute. The platform is also capable of using deep learning and computational modelling to predict stroke.

OSP Labs

With a range of solutions from digital imaging to AI lab testing, OSP Labs uses AI to conduct accurate automated diagnosis for medical diagnosis-related technology



02

AI for Analysis



OmniVision

This tiny image sensor is capable of producing quality images with less than a 2.6mm outside diameter—ideal for endoscopic applications that require a small profile.

BioTeq

Specialising in human implantable technology solutions, BioTeq manufactures the RFID and NFC implants at 125 kHz and 13.56 MHz respectively.

SENSIMED Triggerfish

This smart contact lens functions as a continuous ocular monitoring system—providing insights into the spontaneous changes in the eye 24-hours a day, as a means to guide glaucoma treatment.

InnerEye

InnerEye's device reads visual recognition signals directly from the user's brain. It then combines the visual information with computer vision data using machine learning and signal processing algorithms to analyse and detect visuals.



02

AI for Analysis



Prostate Cancer Detection Device

This non-invasive, easy-to-use biosensor is capable of accurately detecting prostate cancer cells from urine samples.

Bacteria Infection Identification Device

With only a sample size of 7.5 μ L of any biological fluid, by using electrochemical sensing technology, this handheld device is able to detect bacterial cells in less than two minutes.

Core Body Temperature Measurements

Perfect to be used in wearable devices or other health-tech devices with skin contact, this core body temperature sensor continuously monitors core body temperature.

Miniature Digital Spectrometer

Easily incorporated into consumer devices and smart appliances and only 1% the size of conventional solutions, this tiny spectrometer-on-a-chip can measure health parameters like heart rate, heart rate variability, oxygen saturation, blood pressure and glucose.



02

AI for Analysis



Label-Free and Real-Time Nanosensors

These ultra-sensitive infrared sensors can detect 10 times more than the conventional single nanorod antenna array and can be used to detect gas, liquid or biomolecules for environmental monitoring, healthcare or clinical diagnosis.

Touch Sensitive Foam Surface

Flexible and able to detect multiple touch-based movements accurately, this digital foam has a multitude of potential applications from AR/VR controllers to training for surgeons and doctors.

Wearable High Accuracy Non-Optical Movement Analyzer

Easy-to-use and accurate, this wearable tech offer includes an accelerometer, gyroscope and magnetometer to track and analyse movement.

Robotic Capsule Endoscope for GI Tract Inspection

This pill-like miniature camera travels through the body to provide images of the gastrointestinal tract with minimal discomfort. It is taken orally like medication and can help clinicians diagnose a range of diseases like bowel cancer, Crohn's Disease and ulcerative colitis.



02

AI for Analysis



Non-invasive Breath Tests for Lung Cancer Early Detection

This non-invasive breath-based solution can detect early-stage lung cancer by analysing the volatile organic compounds in a patient's exhaled breath. When tested, the tech offer was able to detect more early-stage lung cancer cases than current diagnostic techniques.

Automated Diagnosis of Normal/Abnormal Fundus Image

To reduce time spent on manual assessment of eye imagery, this technology is trained and tested to automatically identify images of age-related macular degeneration, diabetic retinopathy and glaucoma.

CNN for Edge computing & Embedded AI

This software package compresses the large size of convolutional neural network models to be compatible with smaller devices like low-end edge-based systems or embedded systems, allowing for the use of AI in the sector.

Multi-sensing Nanoscale Biochips

Ideal for use as a research tool as well as a home diagnosis device, this tech offer is a platform for assembling different molecular building-blocks between independent carbon nanoelectrodes to detect multiple biological targets.



03

AI for Treatments

One of the most promising applications of AI in healthcare is in the search for new treatments. AI can be used to find the best drug combinations and work out personalised doses to achieve precision medicine's goal of the right drug at the right dose at the right time.

[P1vital® PReDicT Test](#)

The PReDicT Test uses machine learning to provide a rapid, objective measure of a patient's response to an antidepressant, improving the treatment and management of clinical depression.

[Viz.ai](#)

To minimise the systemic delays that stand between patients and life-saving treatments, Viz.ai uses AI to automatically identify suspected vessel blockage and alert specialists.

[AI Platform to Optimise Combination Therapy and Media Formulation](#)

This platform, combined with automated experiments and proprietary arrays, allows for effective and efficient drug discovery.

[Bioinformatics Platform for Genomics-based Precision Medicine](#)

This tech offer was designed to solve the bottleneck of managing and analysing 'omics' data by providing a cloud based interactive digital platform hosted on a supercomputer.

[Bioinformatics Platform for Clinical, Research Oncology and Pharmacogenomics](#)

Designed to facilitate higher clinical and research precision, this tech offer integrates a manually curated clinical-genomics knowledge database, real-world datasets, advanced machine learning analysis and reporting tools to manage and analyse data.



04

AI for Patient Experience

Patients remain at the heart of healthcare and to care for them efficiently, AI technologies can offer analysis to improve systems and resource management.

Detalytics

Detalytics offers analytics solutions that monitor a patient's lifestyle, health, drug response and more. It allows clinicians and clinical staff the ability to manage and intervene proactively with their patients.

AI Millimeter-Wave Indoor Real-time Location System

Based on millimetre-wave technology and AI, this tech offer provides accurate indoor real-time location sensing for better contact tracing, patient flow, equipment finding and fall-prevention.

Wireless Sending Platform for On-Demand Monitoring of Post-Surgical Complications

Consisting of implantable WISE tags that can be clipped on to any suture after suturing, this tech offer allows surgeons to monitor changes at deep surgical sites to discover post-surgical complications even before symptoms appear.



05

AI for Assistive Technologies

Going further than disease prevention and treatment, AI can also provide assistance to patients as they navigate daily activities that they may struggle with.

KinTrans

After using AI to learn and process the body movements of sign language, this tech offer tracks signer's hands and body to translate sign language into voice and text automatically.

KNFB Reader

This easy-to-use reader converts text to speech or Braille for blind, low-vision or dyslexic users.

Echolocation System for the Visually Impaired

This tech offer is a non-intrusive assistive device that emits sound clicks which reflect from surrounding objects and obstacles to help visually impaired users navigate spaces without assistance.

Tactile Sensing Glove

Embedded with multiple tactile sensors capable of measuring each sensing point's pressure and position, this tactile glove can be put on robotic grippers or prosthetic devices to help users 'feel' objects better.



05

AI for Assistive Technologies



Electric Skin

This flexible skin is capable of detecting impact—when used to cover a collaborative or service robot, it signals the robot to stop if it bumps into something or someone.

Supersensitive Iontronic Electronic Skin

This flexible electronic skin contains artificial tactile cells, making it capable of controlling ion concentration and adapting its electric charge to different physical changes. It can be used to measure the electrical movement of organs like the heart, as an electronic skin graft and more.

Conformable, Soft, Tactile Sensor

Designed to detect pressure stimuli and distribution, this low cost, low consumption soft tactile sensor can be used in robotic devices, human-machine interactions, or even to monitor the blood pressure of new-borns.



AI in Healthcare—FUTURE

As artificial intelligence becomes more prevalent, better understood and deployed within global healthcare systems, AI-powered technologies and its applications may soon become more commonplace.

In the next slide, we share on some of the AI trends for the future.



Future of AI in Healthcare



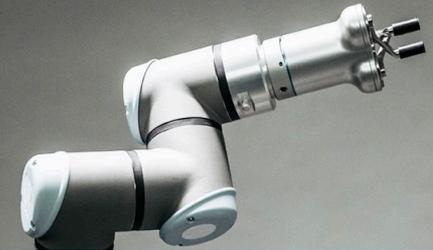
Personalised Implants

- 3D printing enhanced by machine vision and AI can create more customised and complex medical products
- E.g. InkbitCorp



AI-Assisted Personalised Rehabilitation

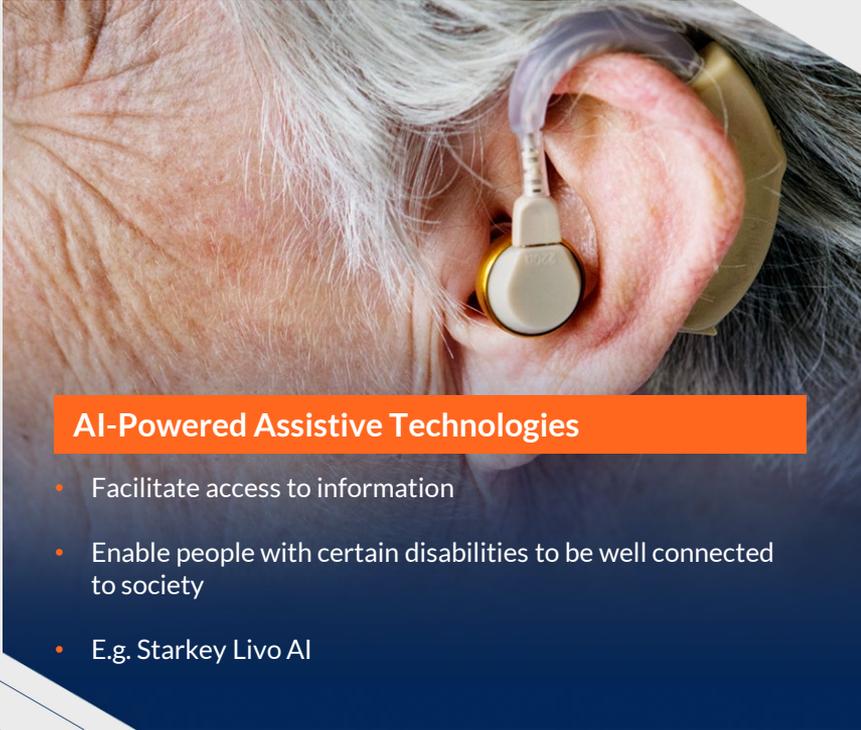
- Conventional exoskeleton systems can self-learn and automate their functions to aid in patient's recovery
- E.g. UniExo



AI-Assisted Robotic Surgery

- Surgical robots can have more precise and accurate movements
- Enable more minimally invasive procedures with improved patient outcomes
- E.g. Verb Surgical

Future of AI in Healthcare



AI-Powered Assistive Technologies

- Facilitate access to information
- Enable people with certain disabilities to be well connected to society
- E.g. Starkey Livo AI



Wireless Body Sensor Networks

- Wearable wireless body sensor networks allow for energy efficient and highly secure data transmission
- Enable health monitoring and medical interventions, more accurate AI predictions
- E.g. NUS Wireless Bioelectronics group

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If you would like to find out more about AI in healthcare and how you can play a role in it, please contact techscout@ipi-singapore.org or visit <https://www.ipi-singapore.org/tech-bundles/ai-in-healthcare.html>



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