Essentials of Artificial Intelligence for Nursing

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Microsoft

Learning Outcome

- After completing this learning activity, the participant will be able to examine technology and the role of nurses in incorporating artificial intelligence into the healthcare setting.

Objectives

Describe how Artificial Intelligence is impacting healthcare

- Introduce the use of artificial intelligence (AI) in healthcare and Nursing
- Briefly describe AI
- Introduce the DIKW framework. Introduce professional responsibility to understand the key concepts and relevant questions to ask
- Introduce the DIKW framework and the quintuple aim as a framework for value-based care

Describe 2 basic Artificial Intelligence principles

- Review the DIKW (data-information- knowledge-wisdom) framework
- Discuss how data can be used by giving examples of real-world applications within the DIKW framework

Describe 2 uses of Artificial Intelligence technology and their impact on nursing practice and patient care

- Description of two AI decision support tools that can help nurses optimize their practice
- Discuss important questions regarding AI/CDS tools that can help nurse leaders identify the optimal technology for improving patient care and nursing practice in their unique environment

"That it will ever come into general use, notwithstanding its value, I am extremely doubtful; because its beneficial application requires **much time**, and gives a good deal of **trouble** both to the patient and the practitioner; and because its whole hue and character is **foreign**, and opposed to all our habits and associations."

John Forbes MD, 1821

"Artificial intelligence represents one of technology's most important priorities, and healthcare is perhaps AI's most urgent application"

Satya Nadella
CEO, Microsoft

Digital Transformation in Health

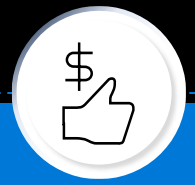
Technology enabled care, health promotion and disease prevention that advances the Quintuple Aim

Better Health

Improve population health

Better Care

Improve the experience of care



Lower Cost

Reduce the per capita cost of care

Clinician Experience

Improve clinician workflow efficiencies

Health Equity

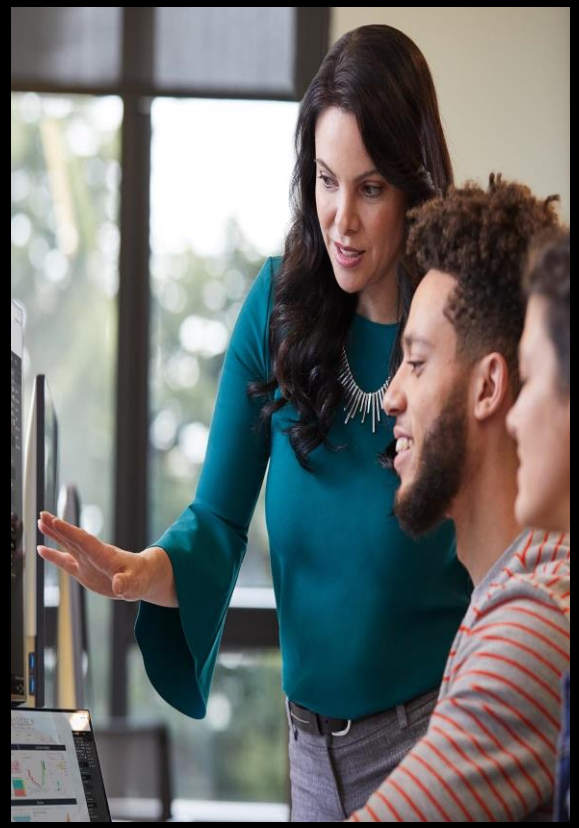
Understanding Social Determinants of Health

JAMA. 2022;327(6):521-522. doi:10.1001/jama.2021.25181

Bodenheimer, T. & Sinsky, C. "From Triple to Quadruple Aim: Care of the patient requires care of the provider" Ann Fam Med Nov/Dec 2014, vol. 12 no. 6 673-576

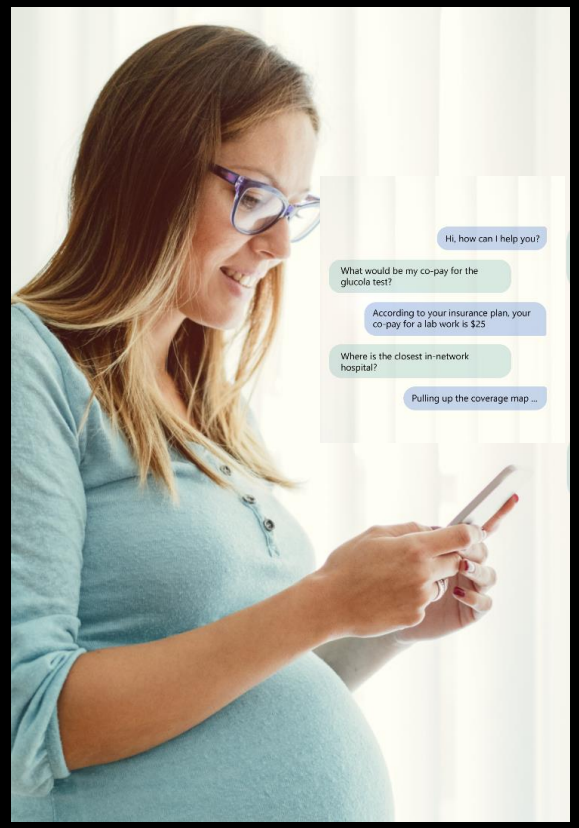
Itchhaporia, D. "The Evolution of the Quintuple Aim: Health Equity, Health Outcomes, and the Economy" Journal of the American College of Cardiology Volume 78, Issue 22, 30 November 2021, Pages 2262-2264

Successful digital transformation is focused on four areas to unlock value



Vision & strategy

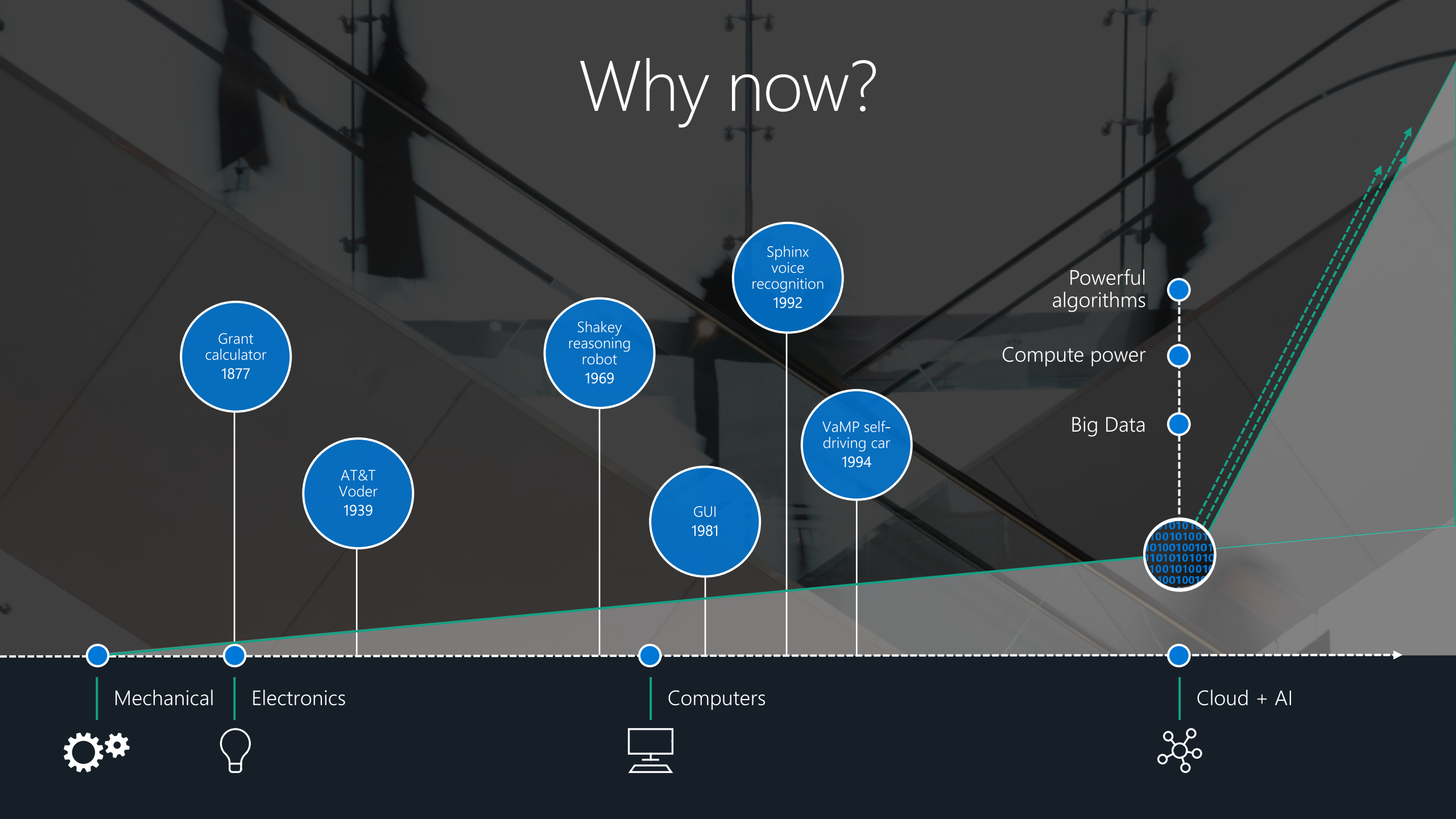
Culture



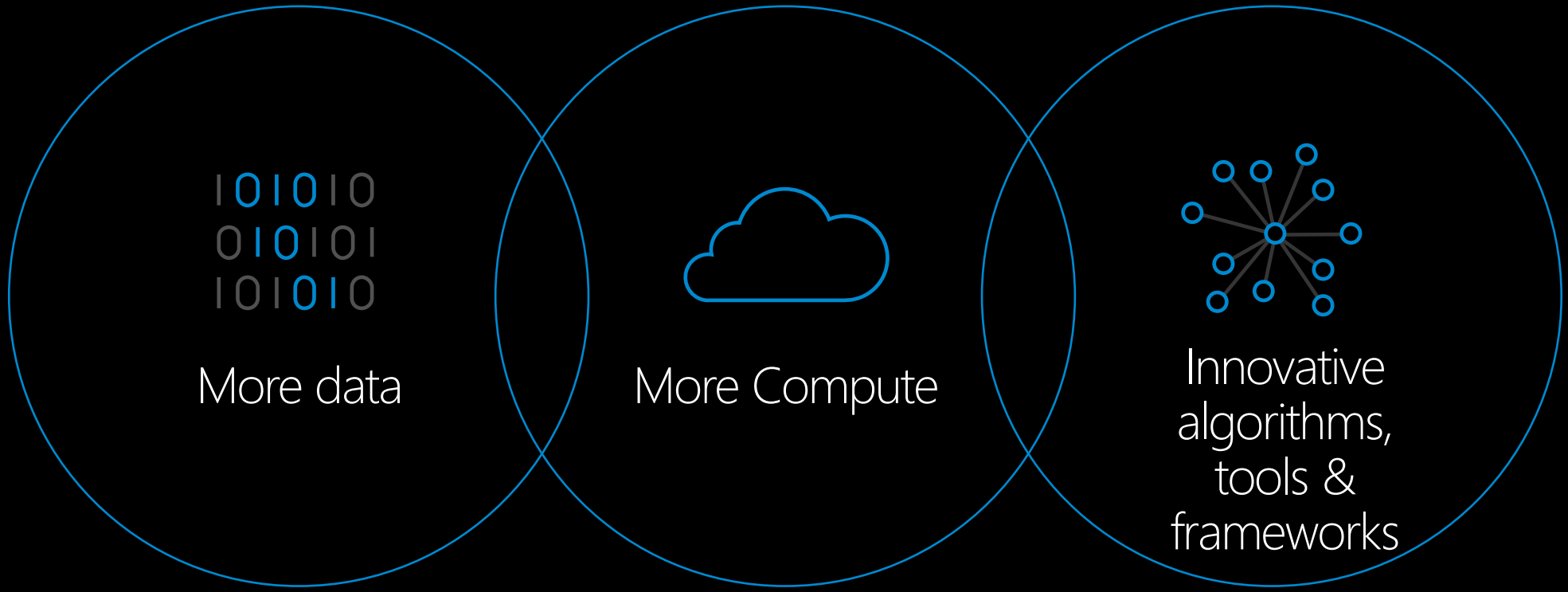
Unique potential

Capabilities

Why now?


Grant calculator 1877
AT&T Voder 1939
Shakey reasoning robot 1969
GUI 1981
Sphinx voice recognition 1992
VaMP self-driving car 1994
Powerful algorithms
Compute power
Big Data
Mechanical
Electronics
Computers
Cloud + AI

Why now?

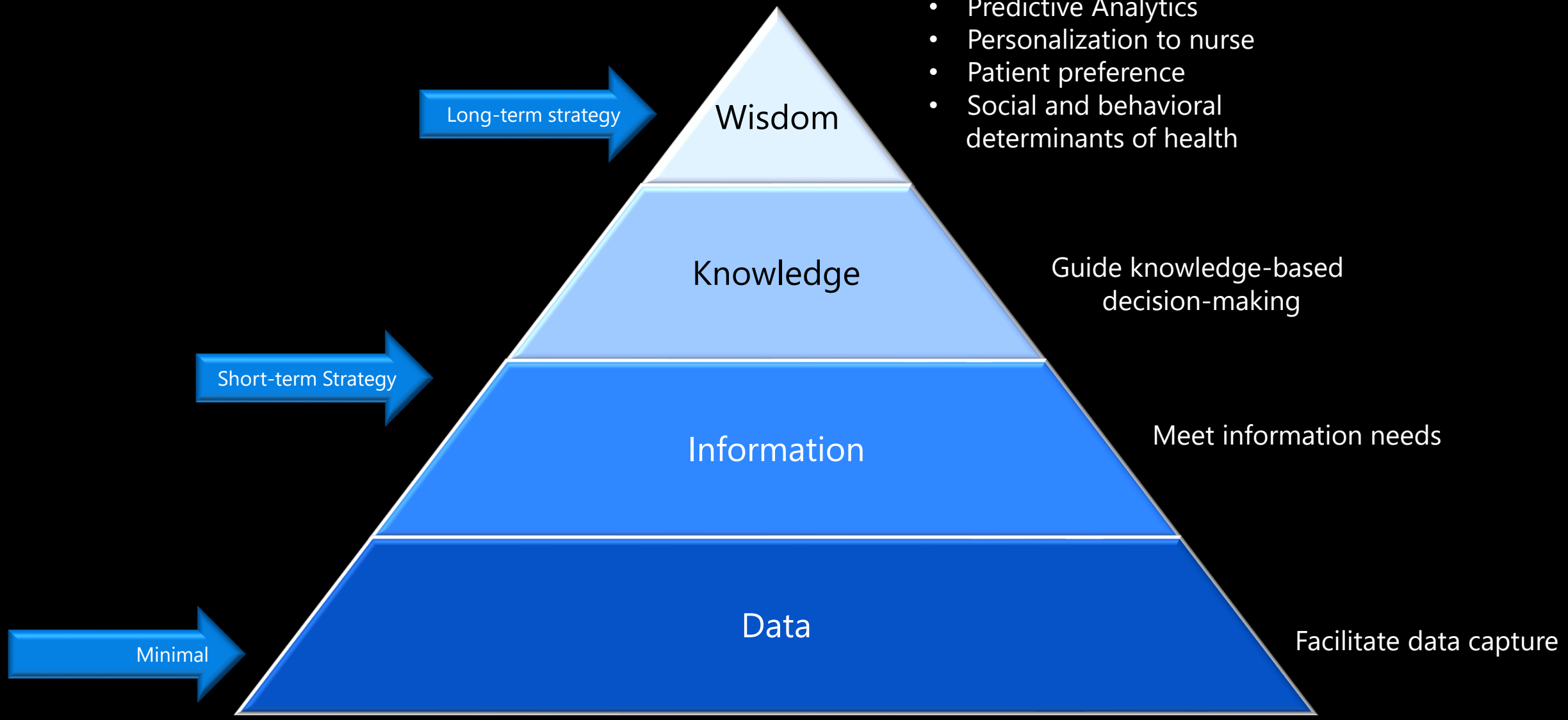

More data
More Compute
Innovative algorithms, tools & frameworks

Data Information Knowledge Wisdom

Concept	Definition
Wisdom	Understanding and internalization of knowledge patterns and relationships
Knowledge	Derived by discovering patterns and relationships between types of information
Information	Data plus meaning
Data	Little or no meaning in isolation

Transforming clinical data into wisdom: Artificial intellige... : Nursing Management (lww.com)

DIKW Strategic Plan



Transforming clinical data into wisdom: Artificial intellige... : Nursing Management (lww.com)

What is Artificial Intelligence?

"AI is an area of computer science that emphasizes the creation of machines that work and react like humans. This means system that have the ability to depict or mimic human brain functions including learning, speech (recognition and generation); problem-solving, vision and knowledge generation."

Amplifying human ingenuity with intelligent technology

Learning

Learn over time without direct intervention

Reasoning

Interpret meaning of data including text, voice, images

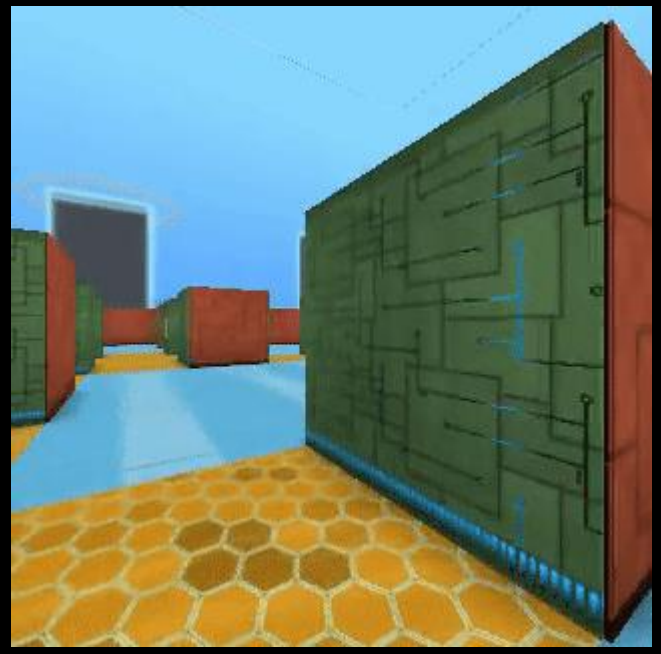
Cognition

Form conclusions with imperfect data

Interacting

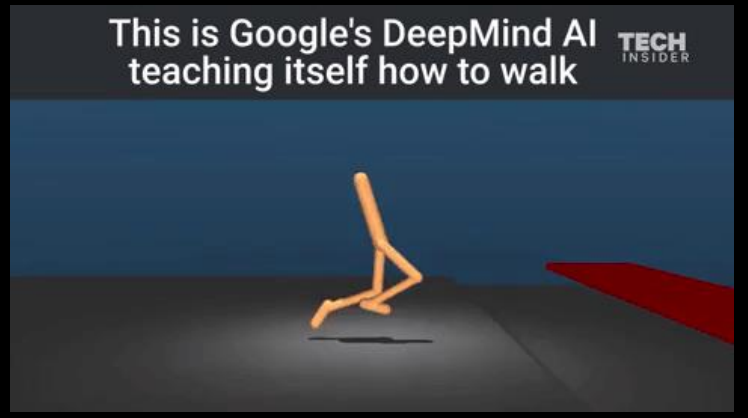
Interact with people in natural ways

Artificial Intelligence (AI)



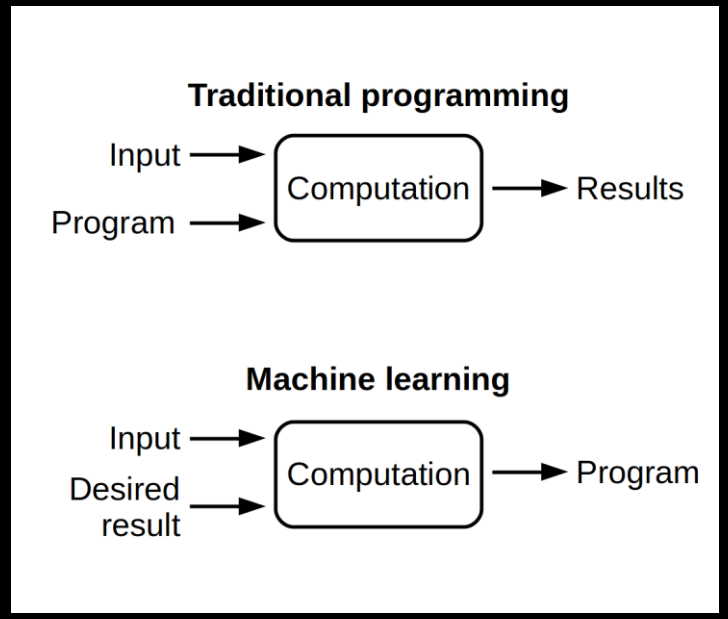
source: https://www.youtube.com/watch?v=M40rN7afngY

The study of “intelligent agents”. Any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals.



source: https://www.youtube.com/watch?v=imOt8ST4Ejc

Machine learning (ML)



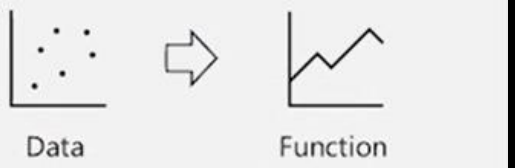
source: https://www.futurice.com/blog/differences-between-machine-learning-and-software-engineering/

The study of algorithms to perform a specific task without using explicit instructions. Instead build a model based on sample data, known as "training data", in order to make predictions without being explicitly programmed to perform the task.

Typically seen as a subset of AI.

Building models

What is a model?



A model is a function, with its parameters learned from data

How is it created?

Machine learning is using a variety of algorithms and techniques to learn the right parameters

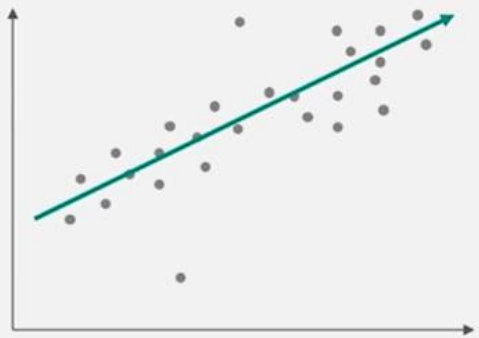
What languages are used?

Majority of ML is done in Python and R, using frameworks like scikit-learn

https://docs.microsoft.com/en-us/learn/modules/introduction-to-ai-technology/5-introduction-to-ml-and-dl

What does a model do?

Regression



F(x) = mx + b

Learn m & b from the data

Classification

Dog .78

Cat .04

Tiger .001

Clustering

- Segmenting customers
- Arranging articles into categories
- Discovering similar items

https://docs.microsoft.com/en-us/learn/modules/introduction-to-ai-technology/5-introduction-to-ml-and-dl

What is Deep Learning?

- Deep Learning describes techniques to build models which use neural networks
- Deep networks (many layers) enable you to learn very complex functions
- Generally, uses frameworks like Tensorflow, PyTorch, Chainer & more
- The math used in training a deep learning model can be accelerated on specialized hardware like GPUs and FPGAs

AI for Health:

When we refer to AI in the context of health we typically mean ML

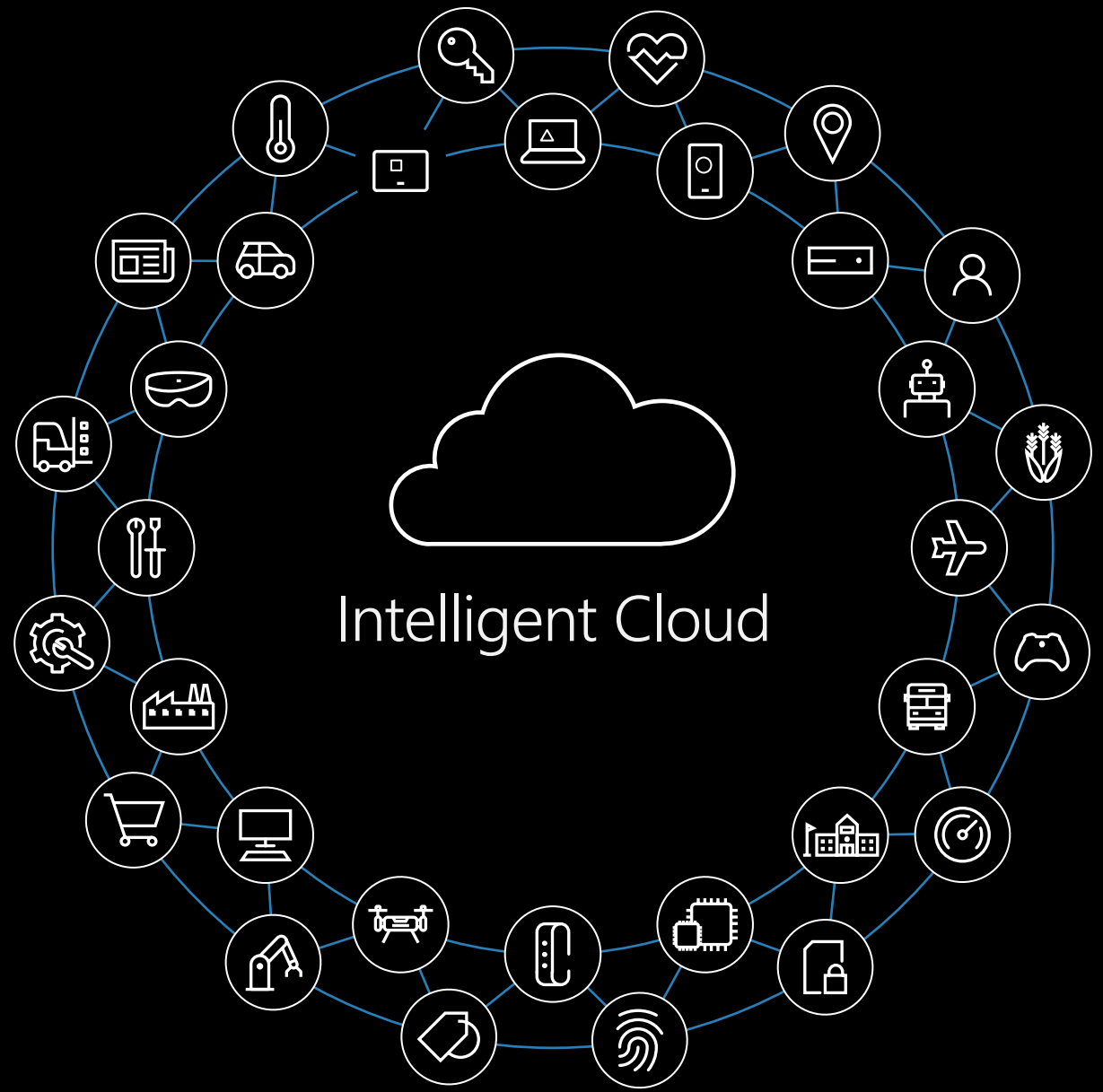
The AI/ML components are individual pieces in bigger health systems, that combine big data, cloud computing, and emerging devices and user interfaces

World view

Multi-device,
Multi-sense

Artificial
Intelligence

Serverless



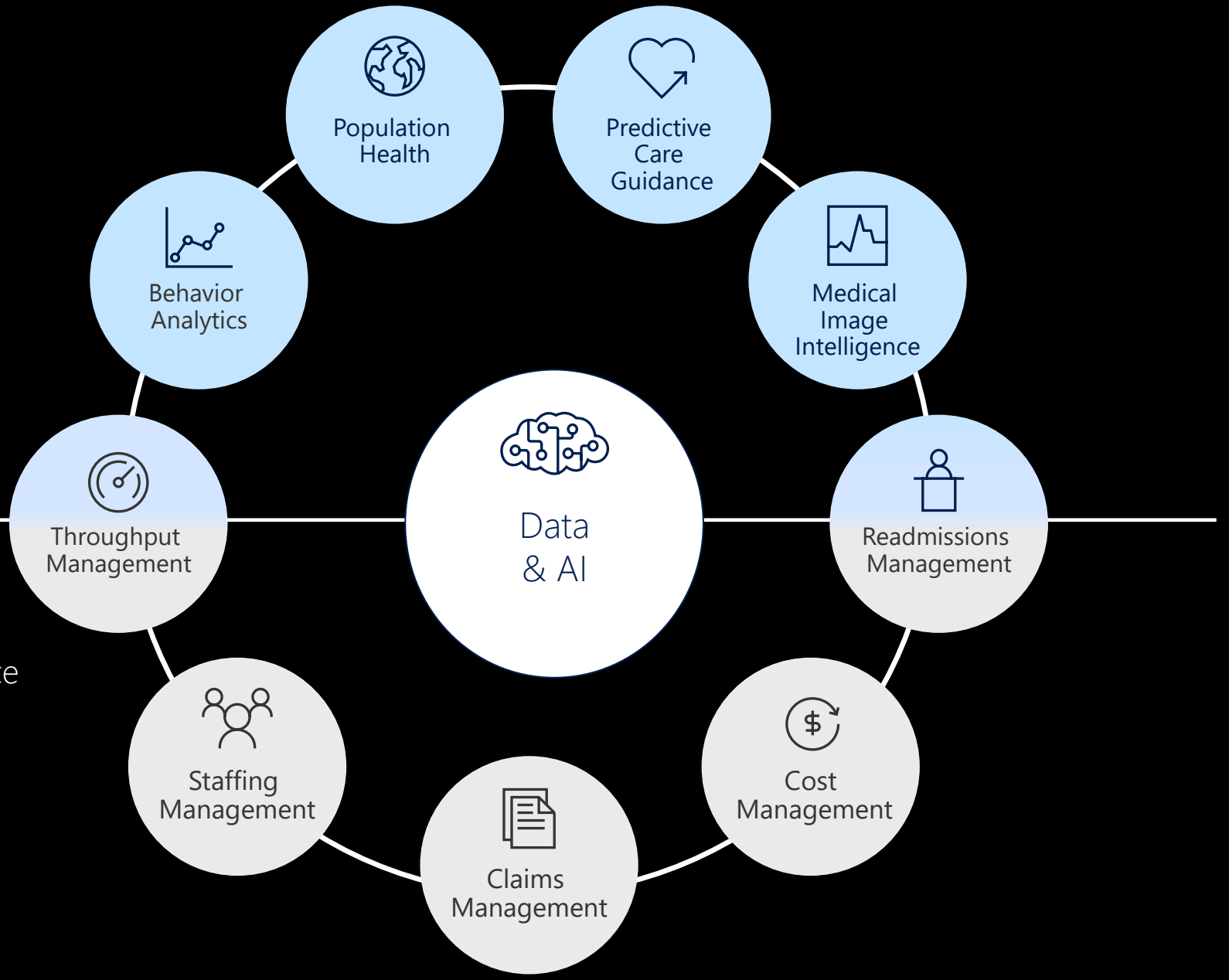
The Bigger Picture: Health Use Case Taxonomy

Clinical Analytics:

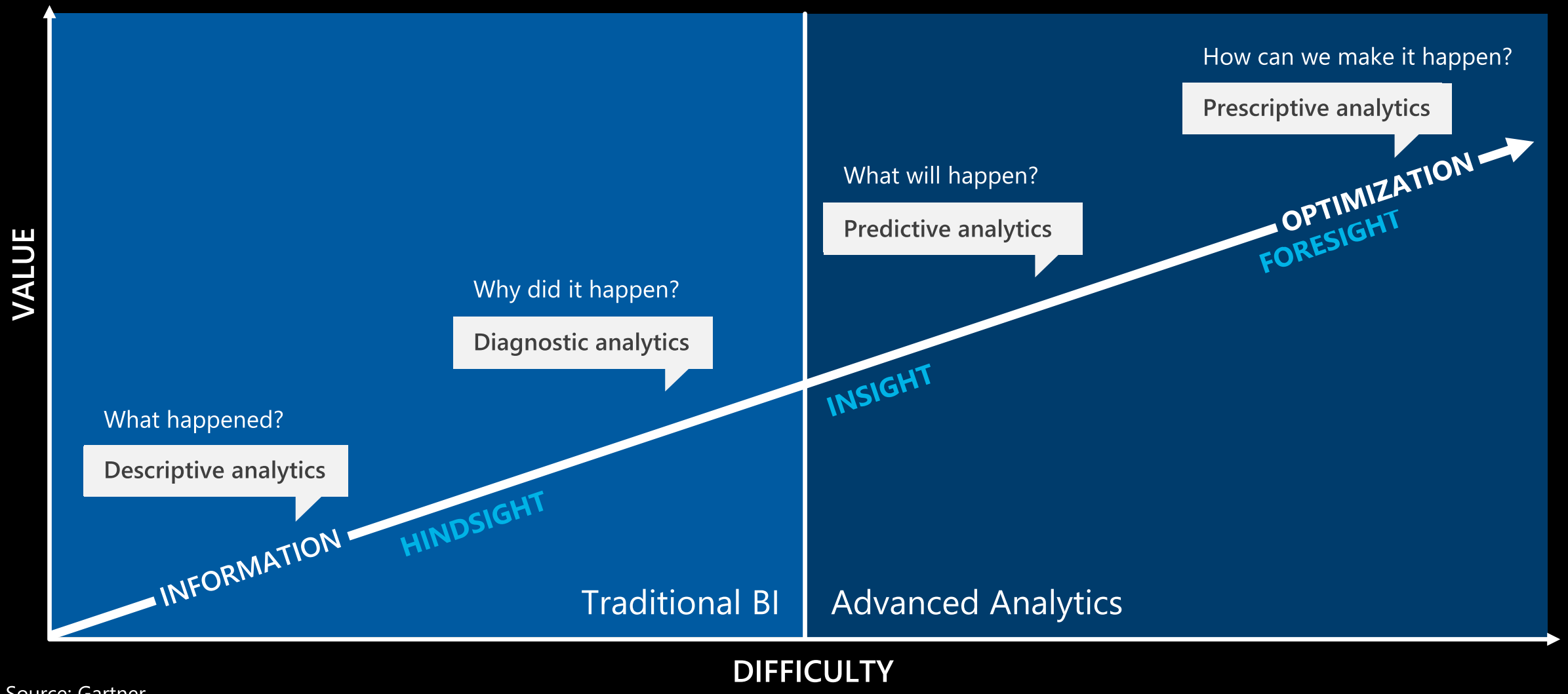
Transform data into prescriptive insights

Operational Analytics

Actionable insights to optimize performance

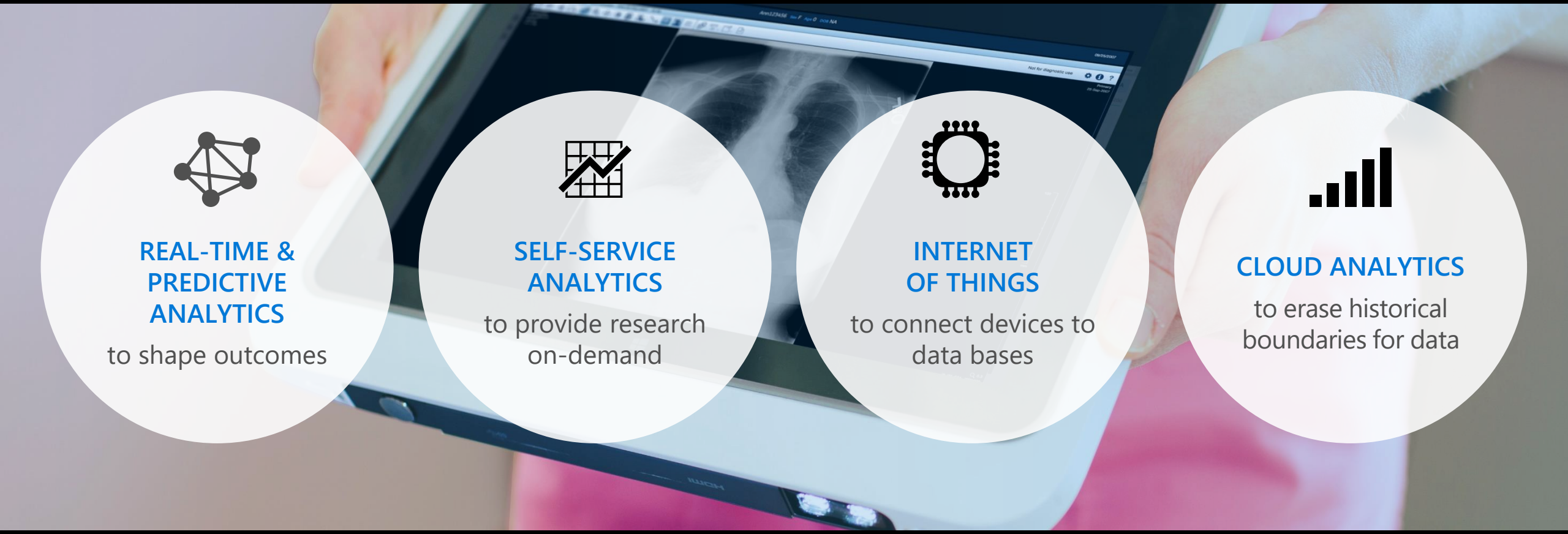


Beyond business intelligence



Source: Gartner

Advanced Analytics in Health: New Paradigms



REAL-TIME & PREDICTIVE ANALYTICS

to shape outcomes

SELF-SERVICE ANALYTICS

to provide research on-demand

INTERNET OF THINGS

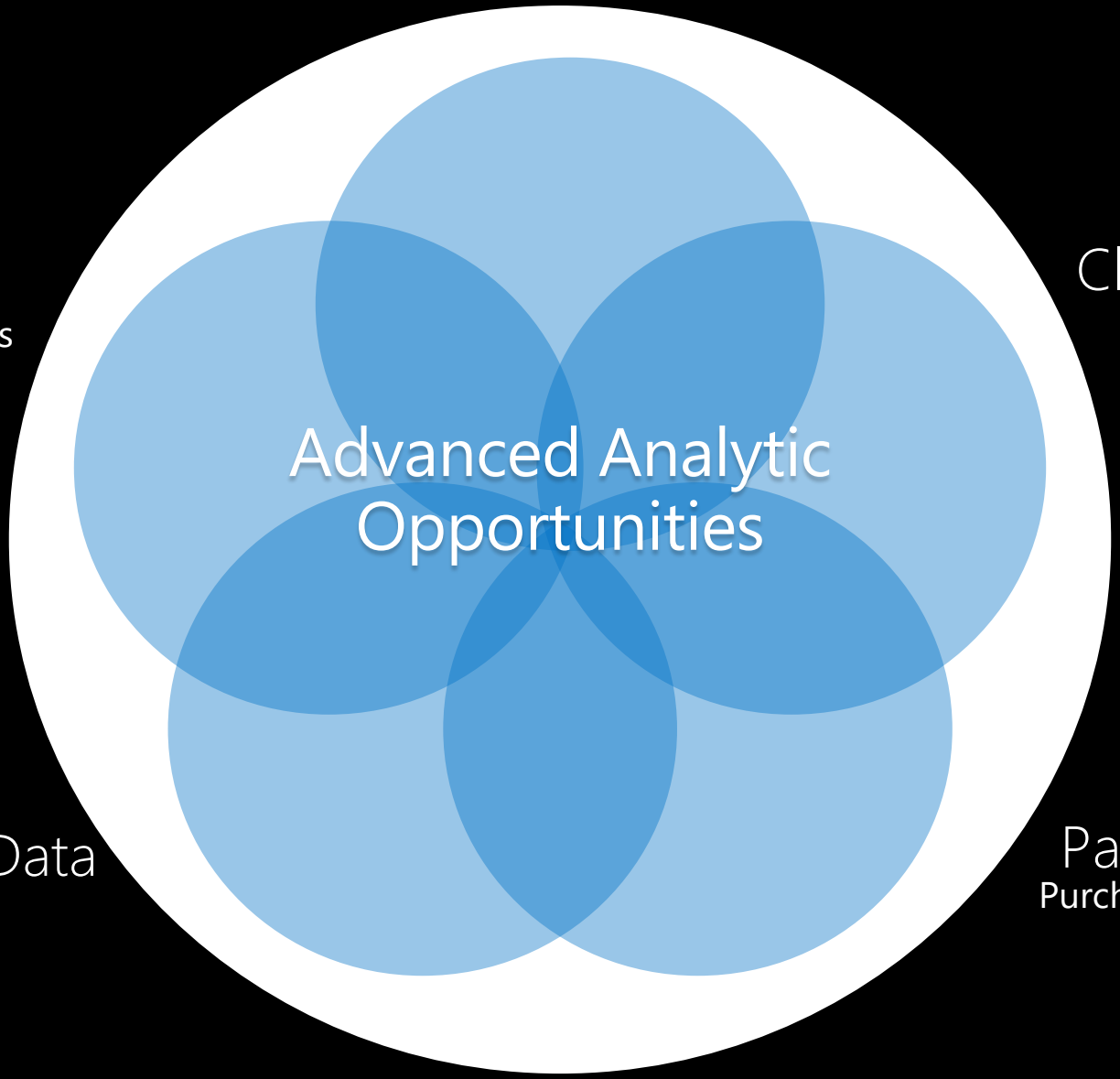
to connect devices to data bases

CLOUD ANALYTICS

to erase historical boundaries for data

Geo/Social/Environmental Data
Weather patterns, economics, social services data etc.

Clinical Data
EMRs, diagnostic images



Claims & Cost Data
Claims, revenue cycle

Pharma & Life Science Data
Clinical trials, genomics

Patient & Citizen Data
Purchasing patterns, open gov data, social media,

Microsoft Cognitive Services

Vision

Image tagging, thumbnails

OCR, handwriting recognition

Customized image recognition

Face detection

Emotion recognition

Video insights

Image and video moderation

Log detection

Speech

Speech to text (speech transcription)

Customer speech transcription (complex word, noisy environment)

Text to speech

Speaker ID and authentication

Real-time speech translation

Language

Contextual language understanding – customize intent analysis

Sentiment analysis, key phrase detection

Test translation up to 60+ languages

Spell checking

Knowledge

Academic Knowledge

Entity Linking

Knowledge Exploration

Recommendations

QnA Maker

Search

Automatic search suggestions

Comprehensive news, image, video results

Entity Information augmentation

Tailored and customized search experiences

Local business search

Systems of Engagement

CRM

Mobile

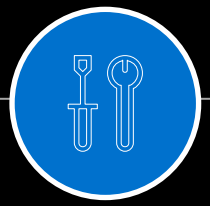
Chat

Systems of Intelligence

Transform clinical services

Engage patients & consumers

Optimize operations



Empower clinicians & employees

Systems of Record

EMR

PAS

ERP

Imaging

AI Maturity Model

Foundational

Questioning what AI is and how to apply it

- Wrong expectations or disappointment
- Low digitization
- Basic analytical

Approaching

Hopeful on AI and its promise

- Digitization under way
- Looking to increase or optimize processes
- Cautious about disruption

Aspirational

Experimented and applied AI

- High digitalization
- Desires new business models
- Achieved a data culture

Mature

Emerging data science and operational capability

- Understands model lifecycle and management
- Building a foundational data architecture

Culture Shift

Ethical Shift

Ownership Shift

AI challenges and risks

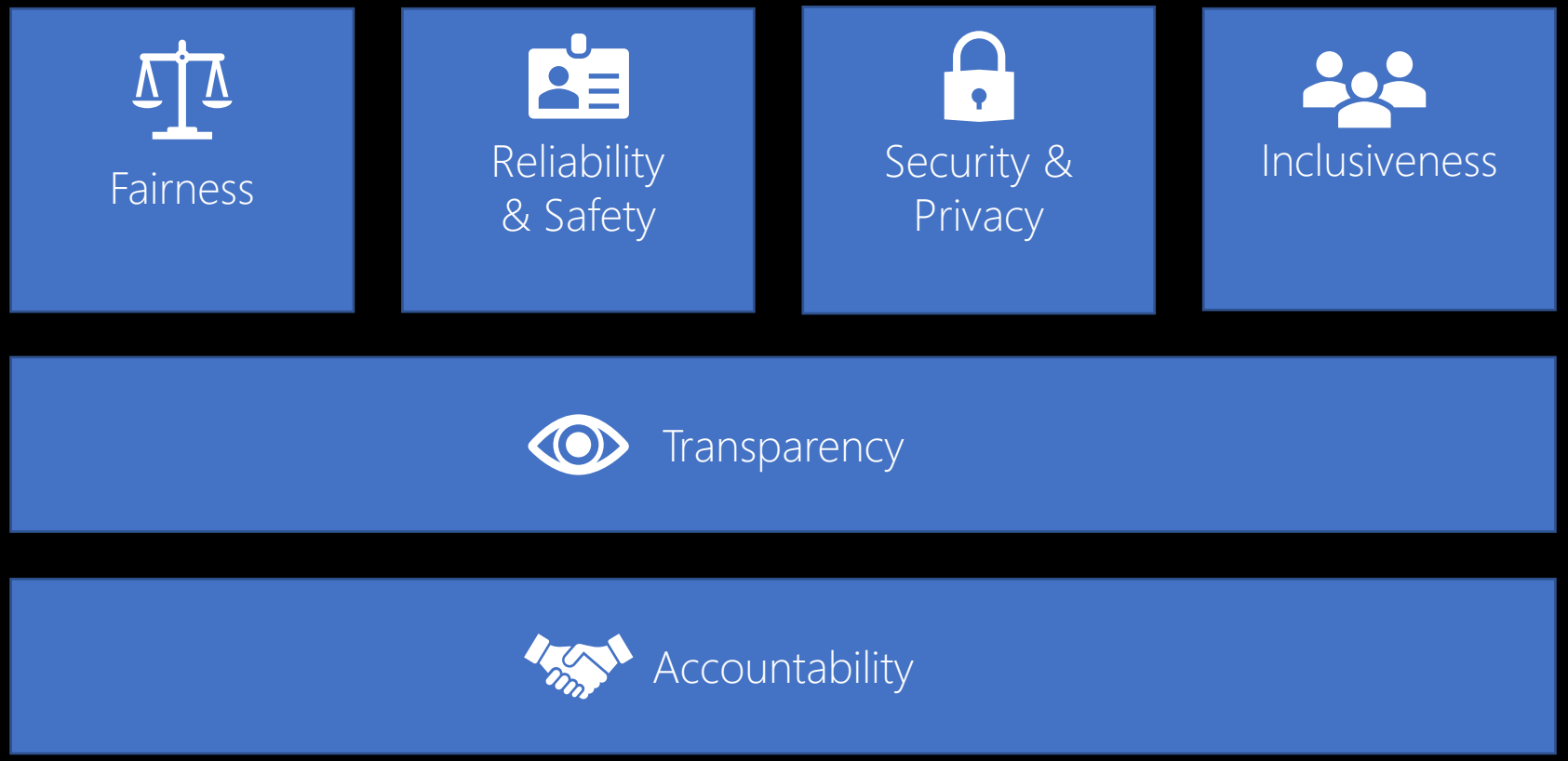
Challenges

- Interdisciplinary effort between ML and medical professionals
- Data that is siloed, unstructured and manual entry
- Data privacy considerations
- Lack of interoperability

Risks

- Exacerbating societal biases
- Loss of jobs requiring training for new skills
- Lack of regulatory oversight

Six principles to guide AI development and use



Concerns of ML

ML models reflect (and often amplify) biases in training data

81% of participants in genome-mapping studies were of European descent.

RESEARCH ARTICLE

Dissecting racial bias in an algorithm used to manage the health of populations

Ziad Obermeyer[1,2,*], Brian Powers[3], Christine Vogeli[4], Sendhil Mullainathan[5,*,†]

+ See all authors and affiliations

Science 25 Oct 2019:
Vol. 366, Issue 6464, pp. 447-453
DOI: 10.1126/science.aax2342

A person's body-hair type can skew an AI's assessment of whether or not he or she has skin cancer.

https://science.sciencemag.org/content/366/6464/447/tab-pdf
https://qz.com/1367177/if-ai-is-going-to-be-the-worlds-doctor-it-needs-better-textbooks/

Concerns of ML

Any discussion about bias in AI will be confusing, difficult, and uncomfortable, because bias is hidden and tricky, until it's obvious and dangerous. That is to say, biased outcomes from a biased algorithm are easier to spot than the biased data fed into the machine.

Bias example

Case study: predicting pneumonia risk

- Predict probability of death for patients with pneumonia so that high-risk patients can be admitted to the hospital while low-risk patients are treated as outpatients
- ML models perform well on this task, BUT closer inspection reveal that on one dataset the models learn HasAsthma(x) ⇒ LowerRisk(x)
- Why does the model learn this (obviously) wrong relationship?

source: https://dl.acm.org/citation.cfm?id=2788613

Why HasAsthma(x) ⇒ LowerRisk(x) ?

BECAUSE it reflects a true pattern in the training data:

- Patients with history of asthma who presented with pneumonia were admitted directly to ICU (Intensive Care Unit)
- The aggressive care received in ICU lowered their risk of dying from pneumonia compared to the general population

Models trained on the data incorrectly learned that asthma lowers risk, when in fact asthmatics have much higher risk (if not hospitalized).

source: https://dl.acm.org/citation.cfm?id=2788613

So what can we do?

- More research on AI and ML fairness on existing models
- Understand and identify problems prior to deploying
- Involve diverse stakeholders & multiple perspectives
- Research on new models appropriate for health applications
  - Interpretable machine learning models
  - Causal models

Questions for Clinical Leaders to ask

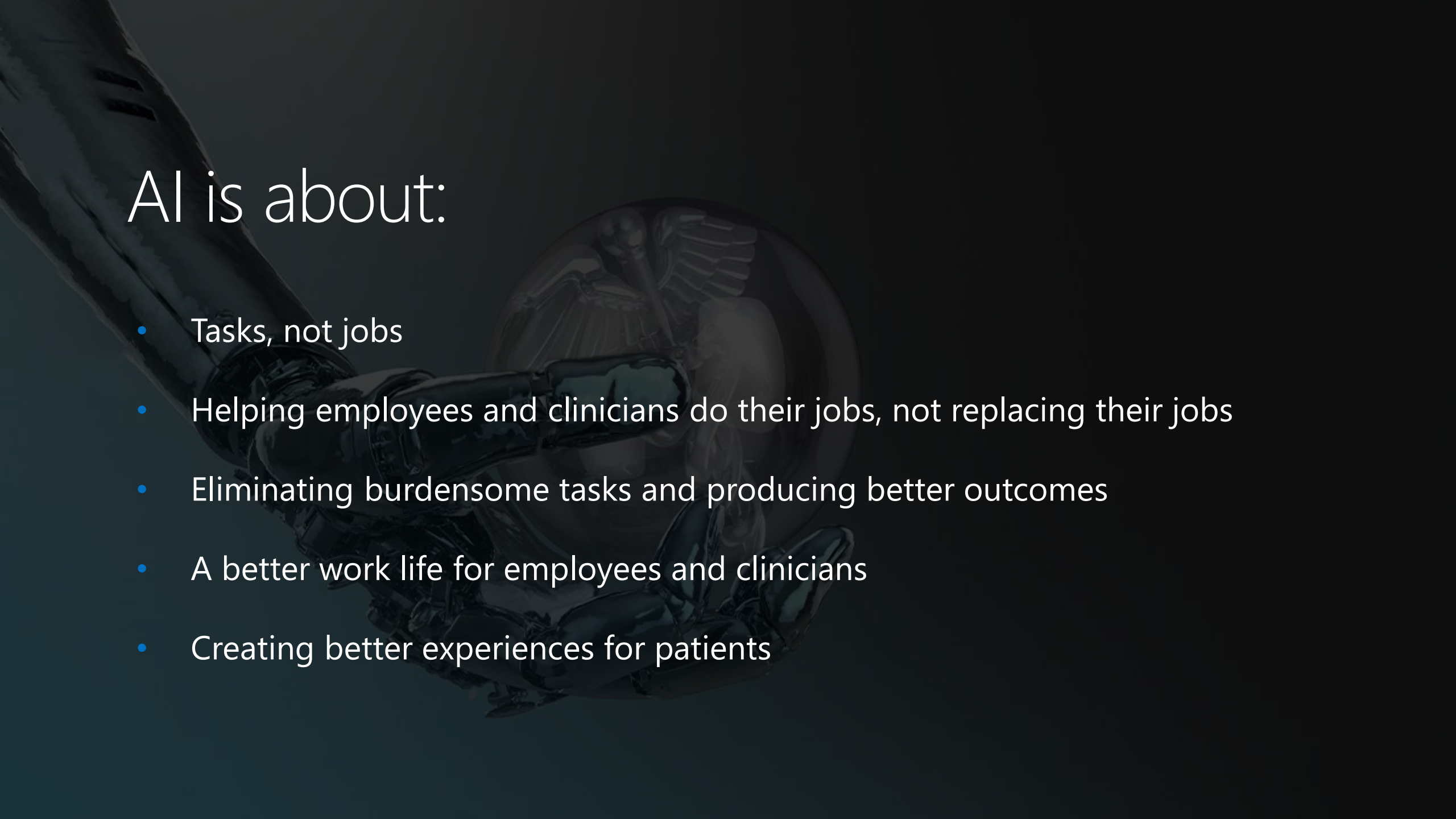
Concept	Question
Data	• What data are used in the AI/CDS tool? • How are data captured? • Does the data capture fit into the existing clinical workflow? • Is there an appropriate life cycle plan for the CDS?
Information	• Does the AI/CDS information take into account the clinical context? • The CDS should be agile enough to adapt to changes in clinical settings. • Does the information produced make clinical sense and have clinical relevance?
Knowledge	• Does the AI/CDS help solve a clinical problem? What were the examples used to teach the model? • Does the CDS fit nursing processes?
Wisdom	• Is the AI/CDS augmenting or taking over decision-making? • Is the AI explainable to the clinician? • Is the required short- and long-term training in place?

Ethical questions?

- What is the plan for thoroughly stress testing AI for unintended biases?
- Are we effectively identifying and managing the ethical implications of technology?
- Can we explain how the AI makes decisions using data?
- Is there a clear breakdown of how the adoption of AI will adhere to the fundamental principles of managing AI in an ethical way?

Responsible advancement of AI

- Demand non-discrimination
- Protect the patient
- Investigate the AI algorithm
- Check the data



AI is about:

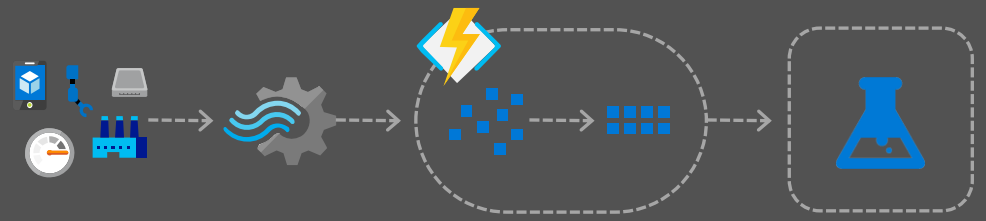
- Tasks, not jobs
- Helping employees and clinicians do their jobs, not replacing their jobs
- Eliminating burdensome tasks and producing better outcomes
- A better work life for employees and clinicians
- Creating better experiences for patients

Critical success factors for AI Integration

- Multidisciplinary team management
- Change management approach
- Culture
- Partnering with AI experts
- Workflow
- Project identification

Emerging cloud & AI application patterns

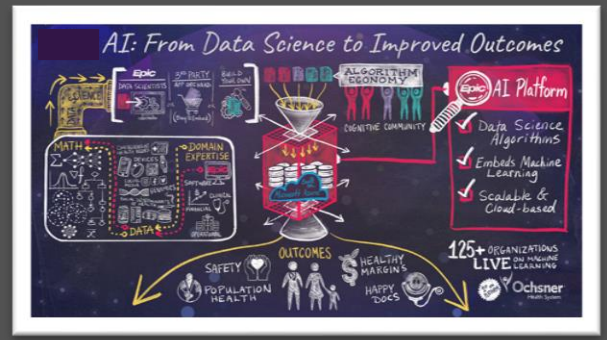
Continuous patient monitoring



Millions of data points & devices streaming data

Data ingestion and normalization

Custom Machine Learning algorithm development



AI infused clinical workflows

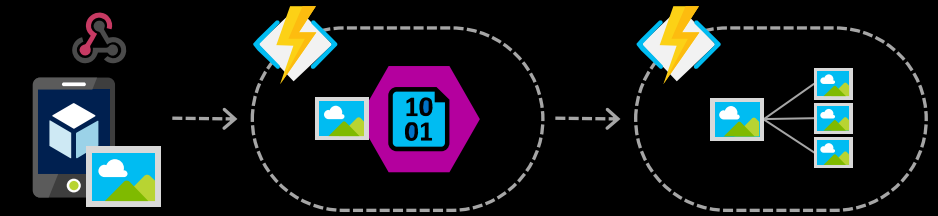
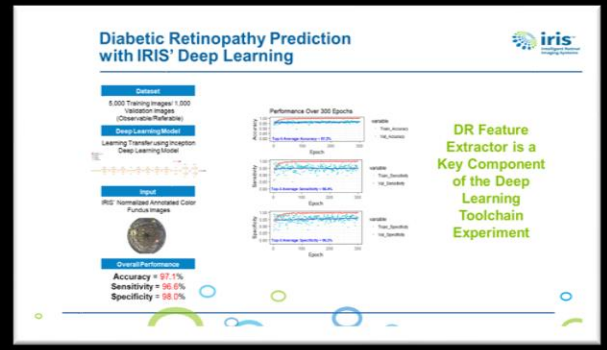


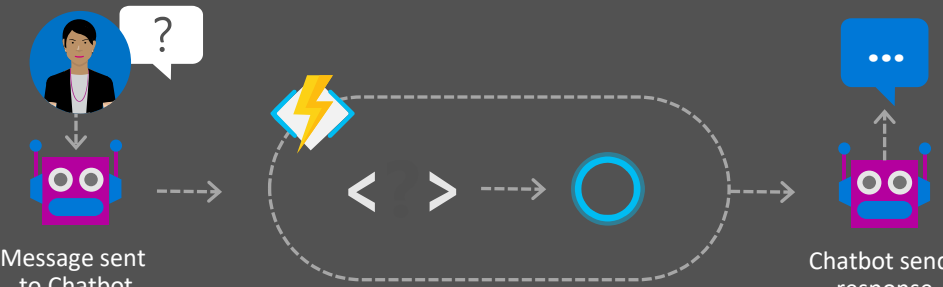
Image taken and function called

Stored in blob storage

Image compared with trained AI model



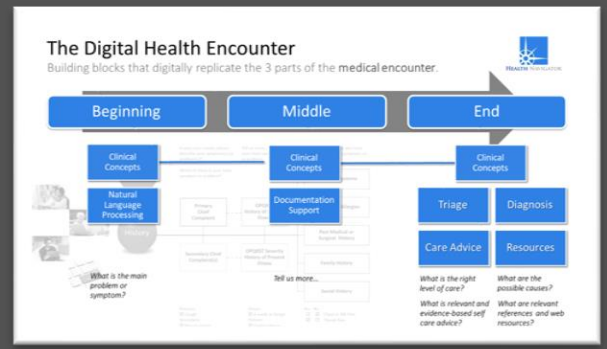
Interactive health agents



Message sent to Chatbot

Cortana intelligence answers questions based on acquired knowledge

Chatbot sends response



Reinventing our health system for the digital age

Accelerating time to diagnosis

Prevent the sick getting sicker

Keeping the sick out of the hospital

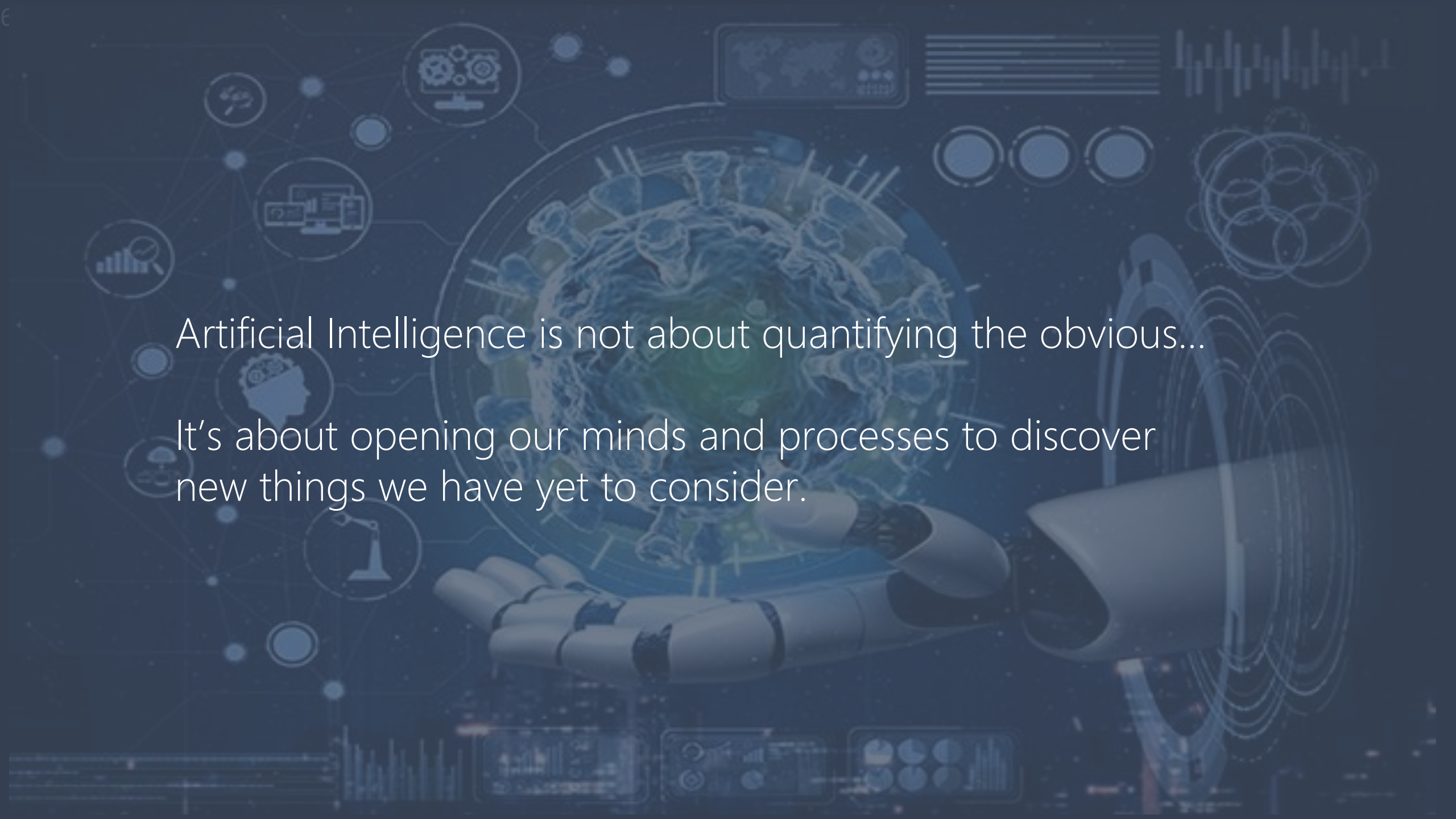
Detecting disease before it reaches us

As “smart” as AI is at certain things, no one has figured out how to imbue or mimic those uniquely human qualities that are essential to the care process.

Wisdom
Reasoning
Judgement
Imagination
Critical thinking
Common sense
Empathy

Transforming healthcare

- AI/ML is disrupting the health industry
- More research is necessary to understand differential implications to different demographics
- Policies and regulations need to catch up with these new models and their applications


Artificial Intelligence is not about quantifying the obvious…
It’s about opening our minds and processes to discover new things we have yet to consider.

Learn more:

https://sponsors.aha.org/HFC-Gen-Microsoft-AI-in-Healthcare2021.html

American Hospital Association™
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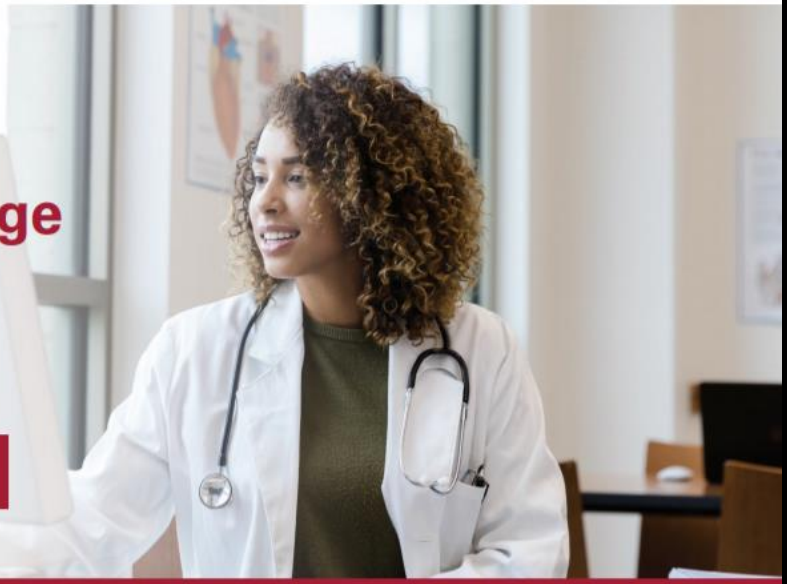

AI in Health Care: Leading Through Change

Join us to learn how AI-powered solutions are transforming health care and earn continuing education credit.

Register for this Complimentary Course ›

Health care is evolving faster than we ever could have imagined. We are in the midst of a health care revolution, driven by Artificial Intelligence (AI). AI is creating a space for innovation and can enable you to work more efficiently and effectively in the face of unprecedented change.

To help you understand how AI is meeting the today's challenges and is shaping your work, the American Hospital Association and Microsoft have teamed up to offer a unique course.

- **Convenient:** Learn on-demand, at your convenience.
- **Fast-paced:** Quickly complete the course in just one hour.
- **Relevant:** Understand the major role AI will play in the future of care delivery. Participants may earn continuing education contact hours.
- **Transformative:** Challenge the way you think about health care from renown instructors.

Thank you

- @kathleen_mcgrow
- https://www.linkedin.com/in/kathleenmcgrow/

Microsoft

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