Building a sustainable data centric strategy in healthcare

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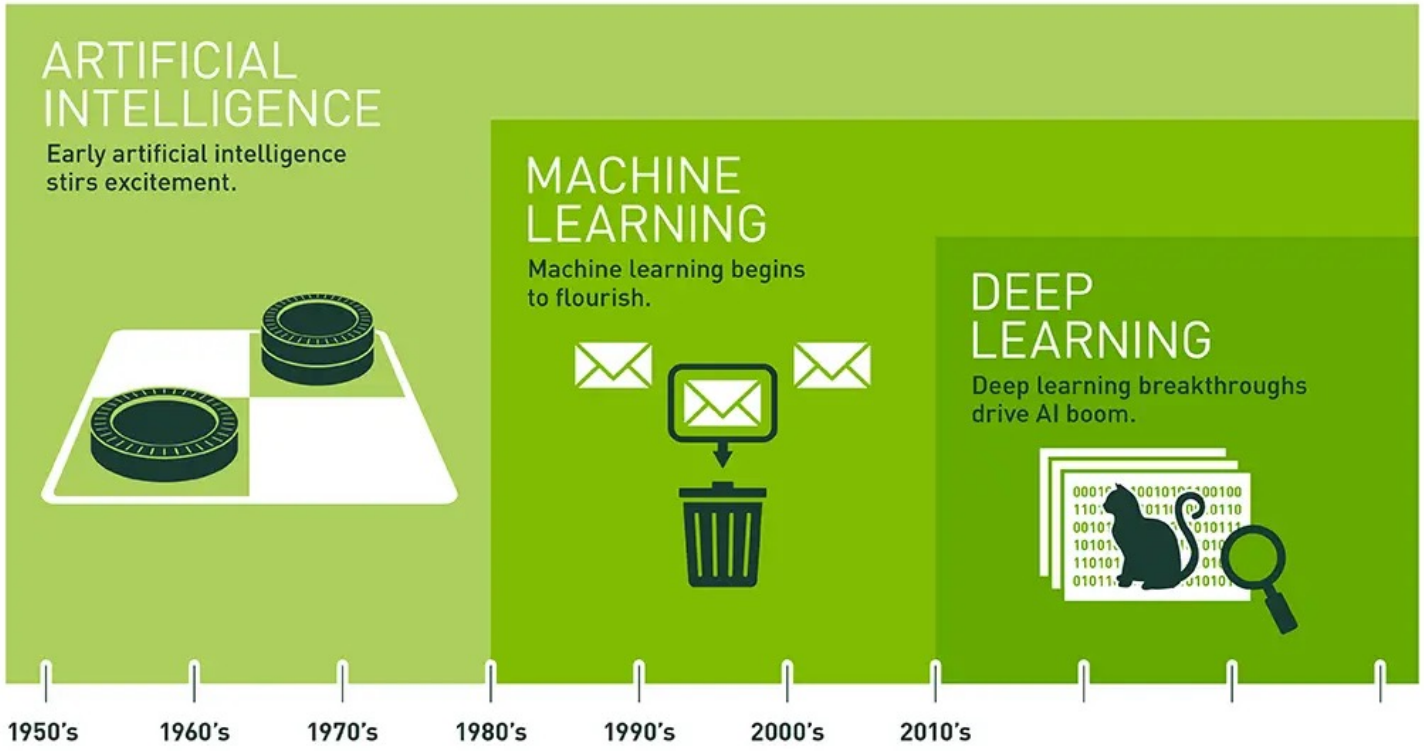
Senior Director of AI

19th April 2024

AI’s promise



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Human Intelligence Replicated by Machines

An approach to achieve AI, where machine learn the rules

A technique for implementing ML, powered by large datasets

NVIDIA: The difference between Artificial Intelligence, Machine Learning and Deep Learning

Gartner's Hype Cycle for AI, 2023

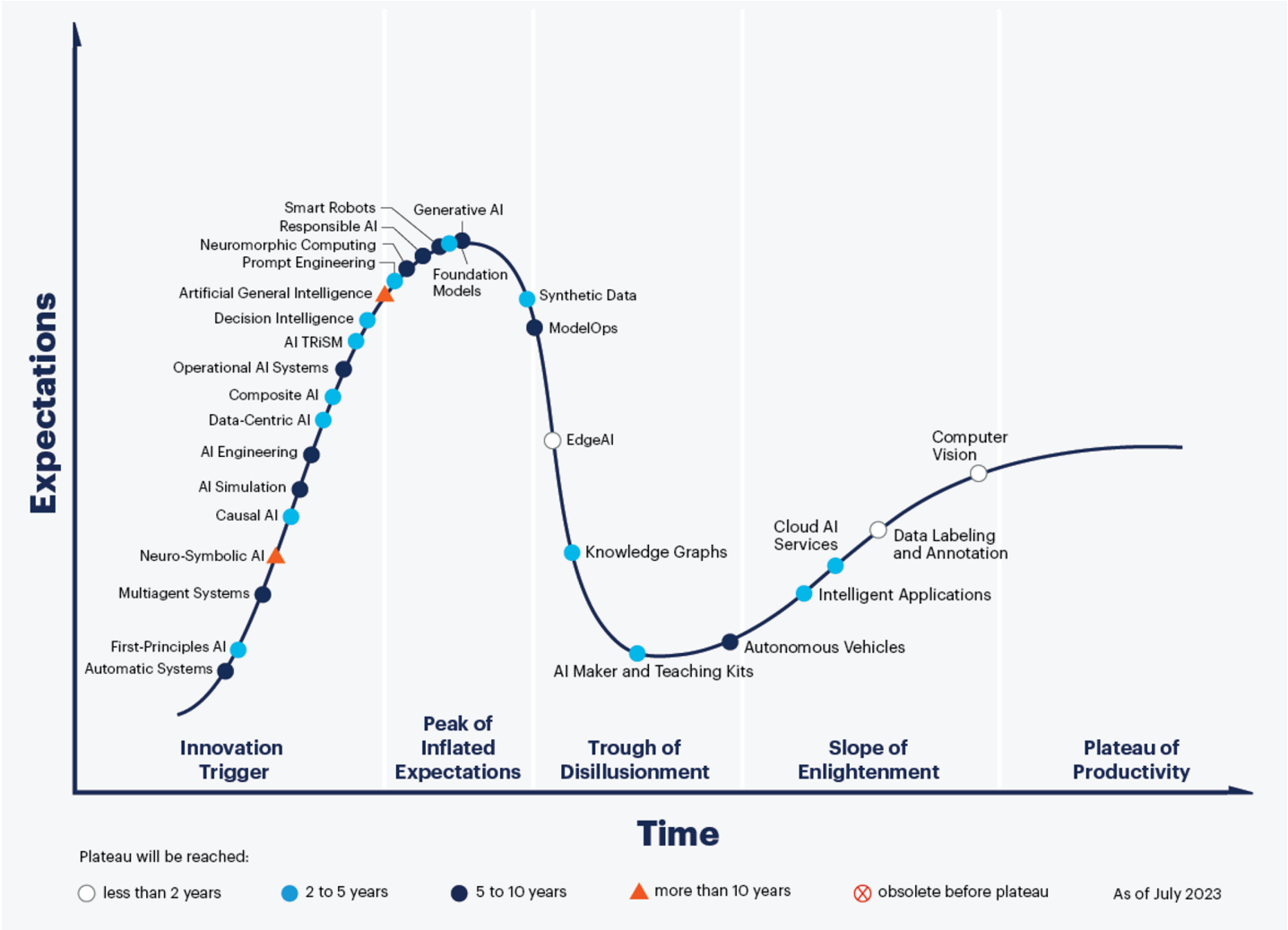
In general, we're bad at predictions. Out of 200 unique technologies, cloud computing, 3D printing, natural language search have made it through

The technical insight is correct, but the implementation isn't there

We've been working on a few core technologies for decades, internet micropayments, large scale data analysis

Some technologies keep receding into the future

Many major technologies flew under the hype curve, MAP/Reduce/Hadoop driving large scale data analysis



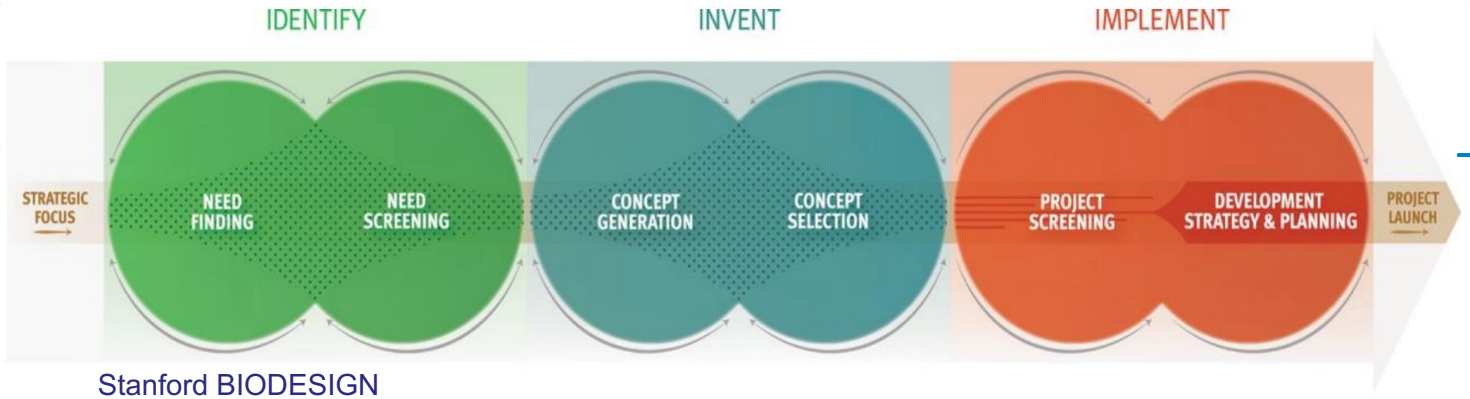
Implementing successfully

Stanford BIODESIGN, a process of innovating medical technologies. Adopted by numerous MedTech companies. Many alumni are/were clinicians

There lots of methodologies already for new product innovation:

- Design thinking
- Jobs To Be Done,
- User-centered design

Example companies initiated by student, faculty and fellows



Stanford BIODESIGN

A patient NEEDS based approach to new product innovation. Companies under invest here.

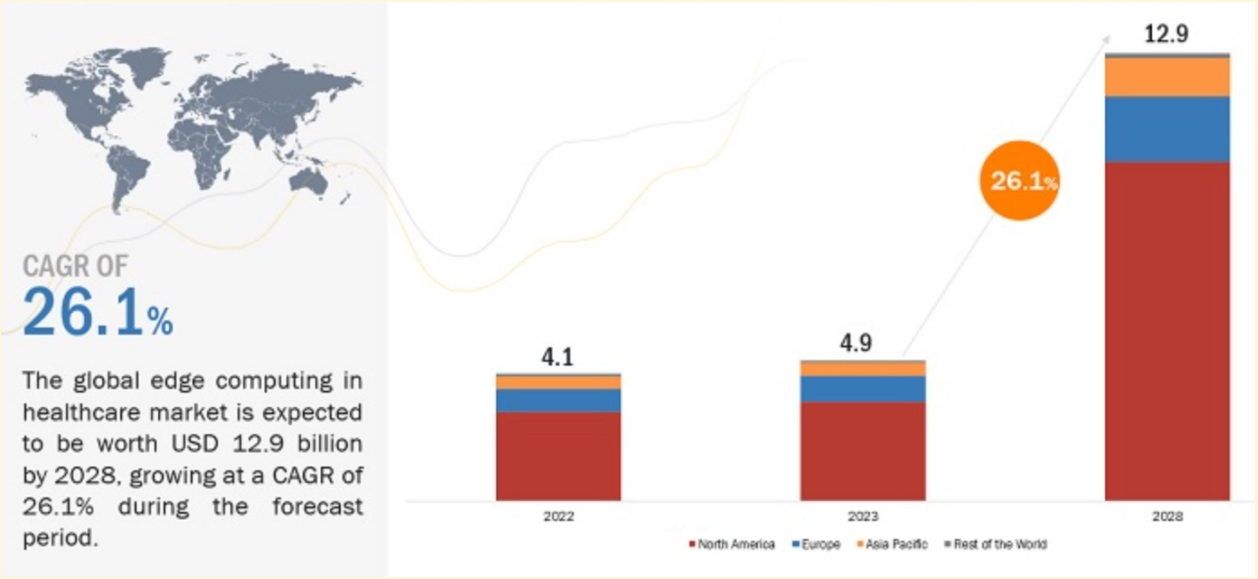
What if your user is the 8 headed monster called Healthcare?

Needs finding should identify a way to address a problem in a specific population in order to achieve a desired outcome

Navigating emerging technology

Edge AI

- Processing of data and execution of AI algorithms directly on devices at the edge of the network
- Data security and privacy are crucial
  - Edge reduces the danger of data leaks by keeping critical patient data locally.
  - Although the challenge may be securing a growing edge ecosystem

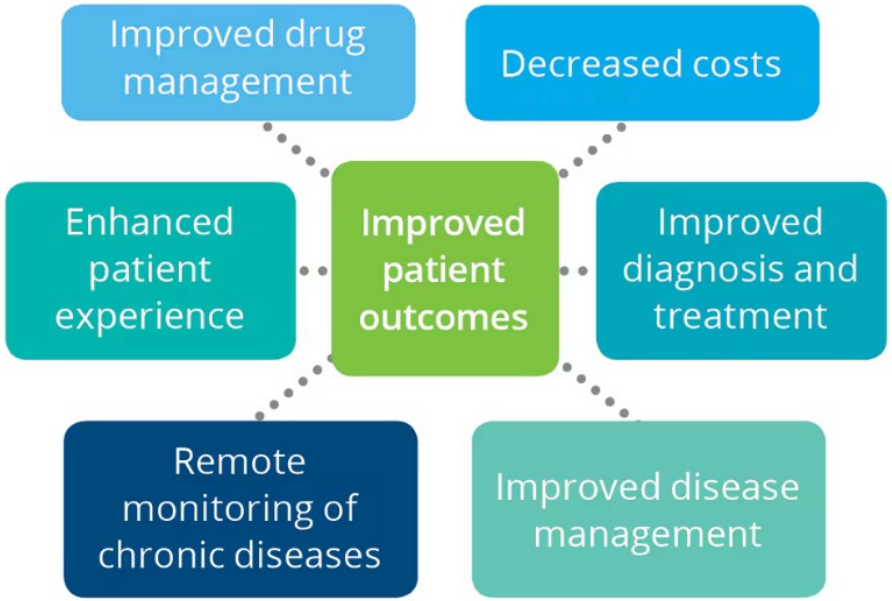


https://www.marketsandmarkets.com/Market-Reports/edge-computing-in-healthcare-market-133588379.html

- By 2025, it is estimated that 75% of medical data will be generated at the edge. These devices are becoming AI enabled, delivering on demand insights (Source: NVIDIA)
- There are several open-source Edge AI frameworks on the market. Their capabilities and characteristics vary considerably with performance, coding language, pre-trained models, commercial support, licensing terms

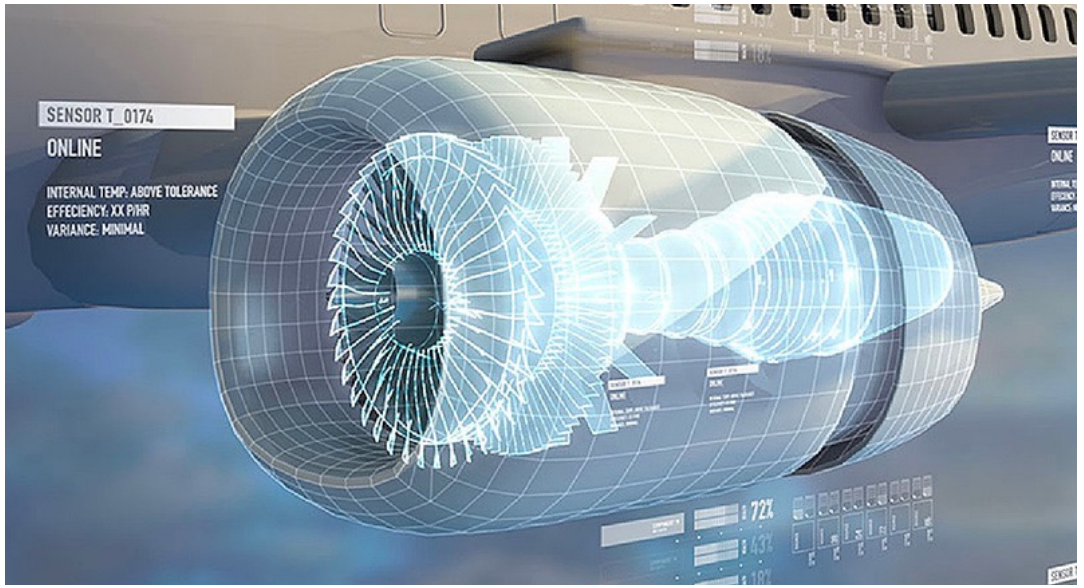
IoMT, Internet of Medical Things

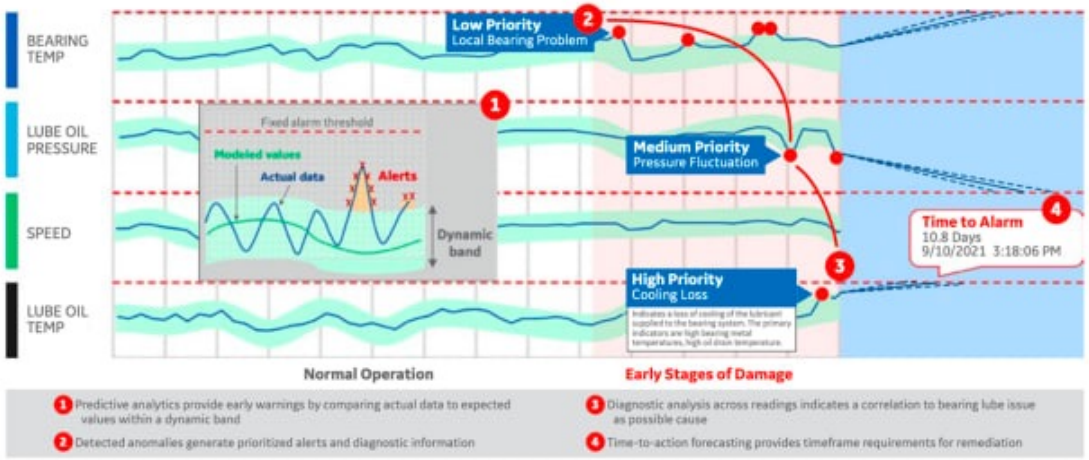
- IoMT market estimated to be worth $158b in 2022



- Helping health care organisations achieve
  - Better patient outcomes
  - Lower climbing health care costs
  - Improve efficiency
  - Activate new ways of engaging and empowering patients
- Challenges needed to navigate
  - Interoperability, collaboration and working towards open platforms needed to ensure data sharing
  - Scalability, both architecting the technology for scale but also Clinicians response to sufficiently adopting the technology to help drive better patient outcomes and economics
  - Cyber security, sufficiently protecting increasingly complex devices

The Digital Twin





GE has transformed jet engine maintenance from schedule-based maintenance to predictive maintenance. Jet engines are no longer serviced on just a routine air mileage basis but monitored continuously with real time sensors and predictive AI models. **Their business model is selling up time**.

Many industries have and are making this transition successfully.

How will healthcare navigate this?

- Modelling human anatomy is another level of complexity
- Building a model in ‘the lab’ vs deploying remotely also brings it challenge

Pharma vs MedTech

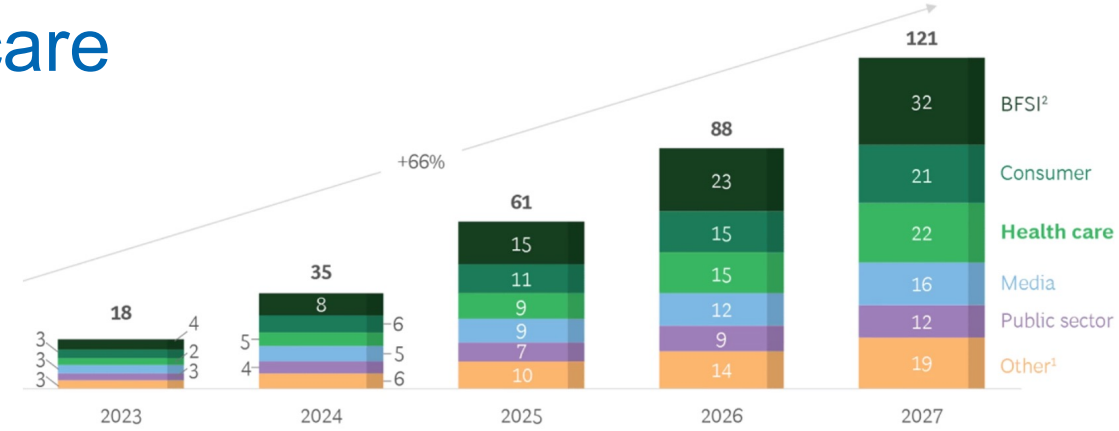
Pharmaceutical sector

- Like MedTech both are focused on patient outcome with some differences:
  - MedTech encompasses a wider spectrum of technologies compared to pharma
  - Pharma products introduce biochemistry-related risks, whereas MedTech heavily relies on practitioners' skills influencing its effectiveness
  - Both rely on patient adherence in their common use of remote patient care
- Utilising RWD
  - GSK announced findings from it’s Asthma and COPD real world study in 2017
  - Drug licensing is evolving
  - More broadly, surveillance data and registry data bodies are working to also evolve
- Is Pharma collaborating better than MedTech? What are common problems we should be solving together?

The case for LLMs

Generative AI opportunity in Healthcare

Generative AI is projected to grow faster in health care than any other industry, with a compound annual growth rate of 85% through 2027, to reach a total market size of $22 billion
https://www.bcg.com/publications/2023/generative-ai-in-medtech

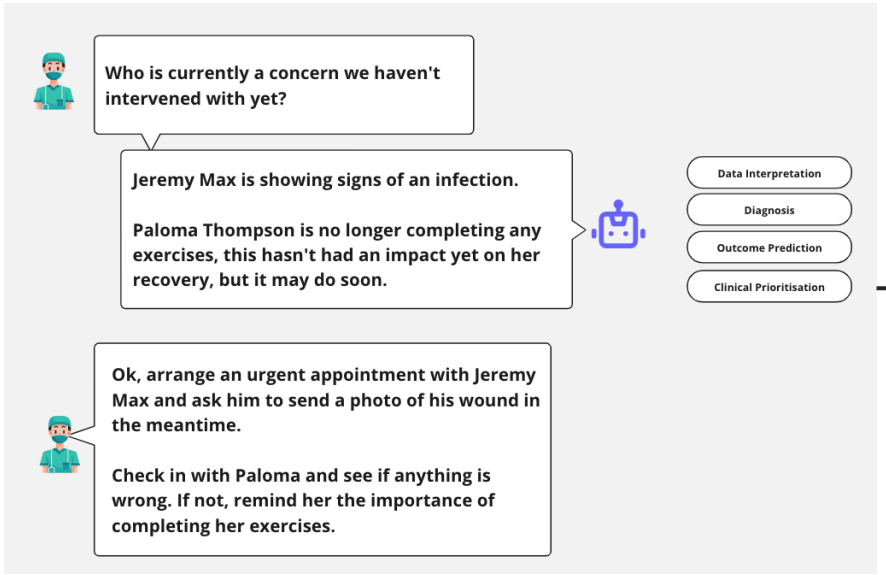


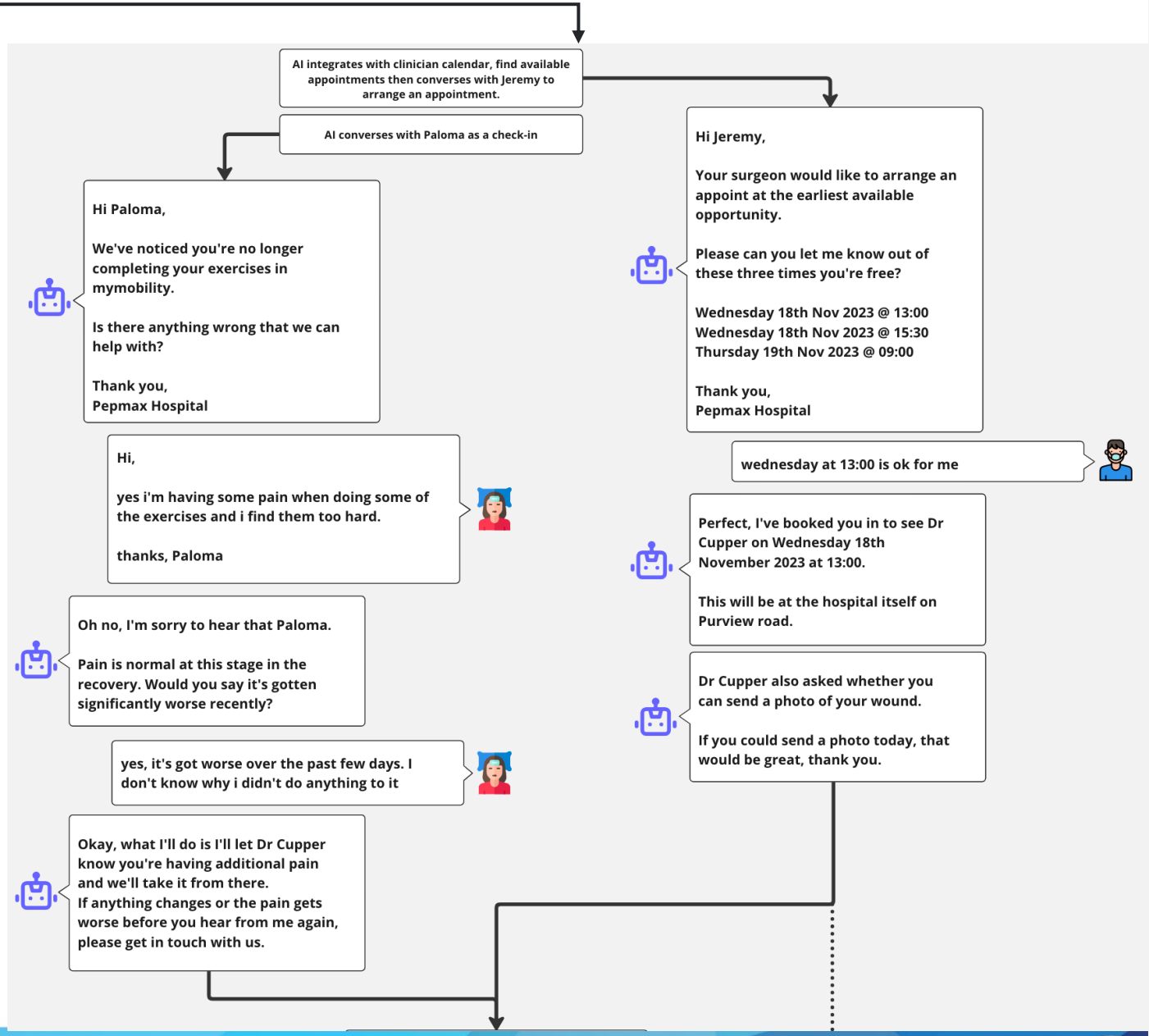
It has significant potential in healthcare and is likely to become integral in future healthcare practices sooner than most of us would have thought a few months ago
https://www.bcg.com/publications/2023/how-generative-ai-is-transforming-health-care-sooner-than-expected

Based on the first published studies, three main areas of focus for ChatGPT emerged, namely clinical use, answering medical questions and assisting in education, and scientific writing and research
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10025693/

Microsoft has invested $10 billion in OpenAI, developer of ChatGPT. The latest version GPT-4 passed the US medical licensing exam by 98%, diagnosed a 1 in 100,000 condition in seconds, it can demonstrate clinical judgment and diagnose disease at least as good as any doctor
https://www.forbes.com/sites/qai/2023/01/27/microsoft-confirms-its-10-billion-investment-into-chatgpt-changing-how-microsoft-competes-with-google-apple-and-other-tech-giants/

GenAI use case #1
Virtual Care Team





Simplify the care management experience by having autonomous, instruction driven agents carry out tasks such as arranging appointments, checking in with patients and responding to queries

GenAI use case #2

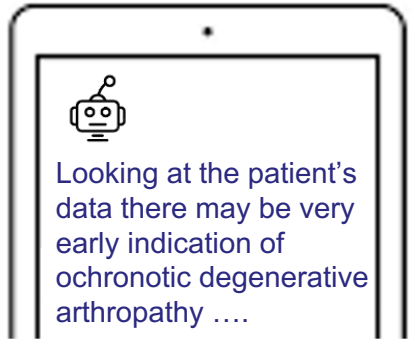
Virtual Assistive Clinical Expert

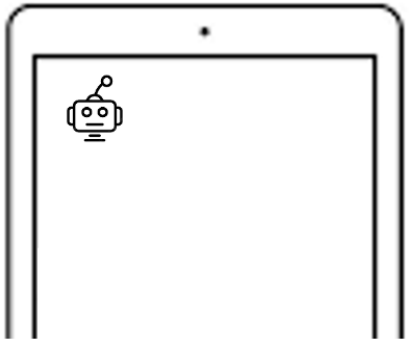
Surgeons and clinicians utilise a GenAI based assistant throughout the whole episode of care …

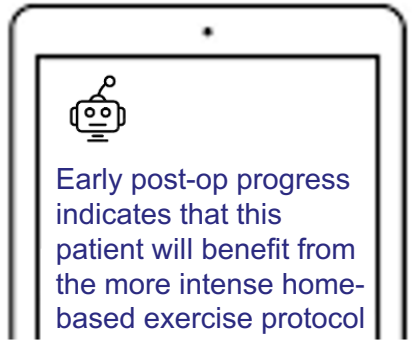
The assistant can operate continuously in the background or be called upon to assess specific concerns

It can assist in complex cases and looks for hard to identify problems

It can proactively monitor patients and recommend early interventions







Generative AI – How should you apply it?

We utilize an enterprise offering like GPT-x models, which means:

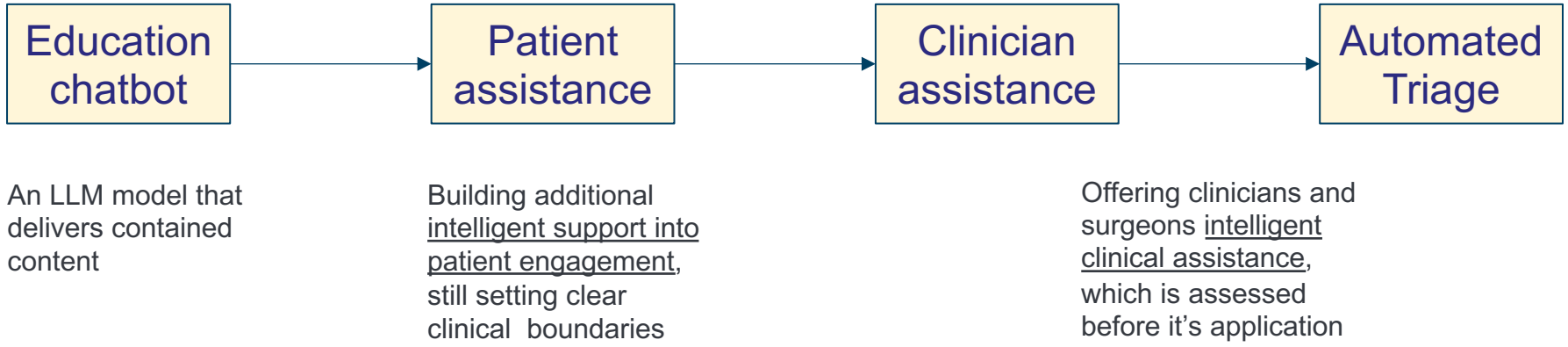
- You can control the version of GPT that you use
- You define the constraints and remit in which the AI models can operate
- The service does **not** collect data
- Utilize data protection and security measures that naturally come with an enterprise offering

It should not be ChatGPT / Bing Chat / Google Bard based products, which:

- Leverage GenAI in an uncontrolled way
- Share proprietary data
- Lack built in security
- Utilize unmanaged content sources
- Offer limited ability to verify accuracy, e.g., hallucination

Building a Generative AI roadmap

- While LLMs can already deliver incredible clinical triage, we will have to deploy them in a staged approach, example shown:



- As we progress products through this LLM roadmap we will have to navigate legal, regulatory, compliance and quality requirements

Generative AI

Who is already deploying products in Healthcare/MedTech?

Nuance and Microsoft Announce the First Fully AI-Automated Clinical Documentation Application for Healthcare

https://news.nuance.com/2023-03-20-Nuance-and-Microsoft-Announce-the-First-Fully-AI-Automated-Clinical-Documentation-Application-for-Healthcare

HCA Healthcare: Improving documentation and workflow for clinicians, a solution that extracts information from physician-patient conversations to help create medical notes.

https://investor.hcahealthcare.com/news/news-details/2023/HCA-Healthcare-Collaborates-With-Google-Cloud-to-Bring-Generative-AI-to-Hospitals/default.aspx

MediTech is working to power the search and summarization experience within their EHR, MediTech Expanse

https://ehr.meditech.com/news/meditech-and-google-health-collaborate-to-advance-clinical-search-and-discovery-in-expanse-ehr

Glass.Health using generative AI, they can process patient symptoms and compare them with a vast knowledge base, providing physicians with additional insights and potential treatment options

https://glass.health/

Zepp, releasing generative AI powered smart wearables targeted at both Sports and Healthcare

https://www.zepp.com/blog/generative-ai-powered-smart-wearables-changing-the-game-in-sports-and-healthcare

Engineering to build sustainable data products

The process to build a viable data product

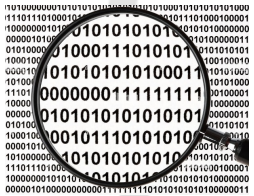
1

Acquire data:

- Prepare data
- What additional data do we need?
- Do we have sufficient volume?

2

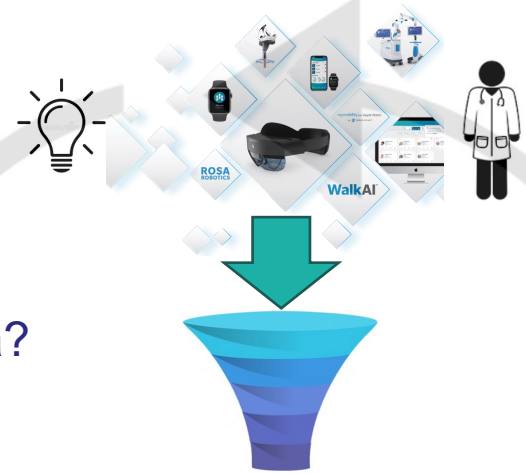
What can we see in the data?



2

Product definition:

A multitude of product opportunities from advisors, market and continual improvements



3

Early de-risk:

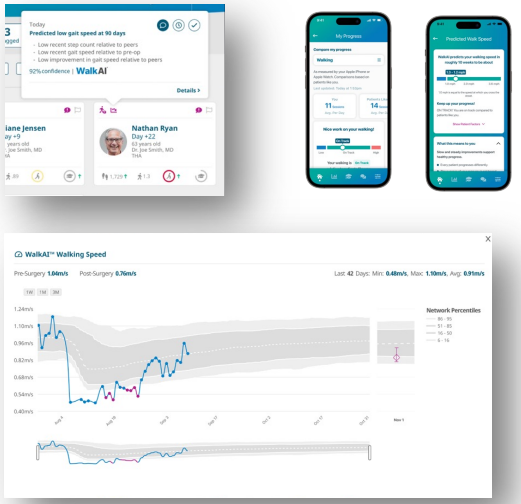
Is there a signal?
Is it technically viable?

4

Iterative product concept development

=

A rigorous process necessary to get AI products into market



Ability to build and deliver sustainable AI products at scale

The AI Platform supports the whole end to end process from building to deploying data products into markets

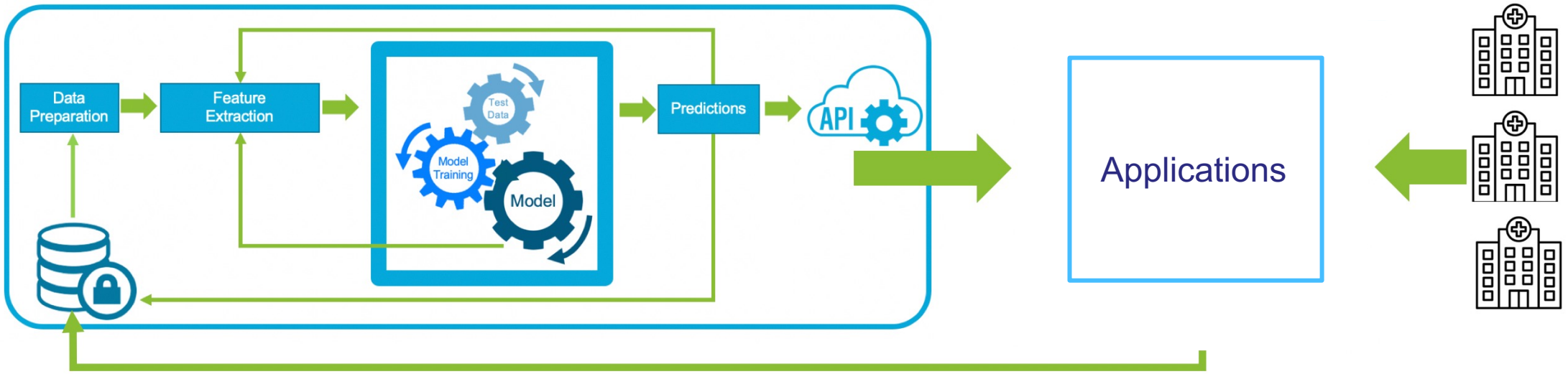
This standardises the way we work

Optimises the build and ensure maximum re-use

A controlled environment building AI products as medical devices

A platform that enables models to run continuously in near real time

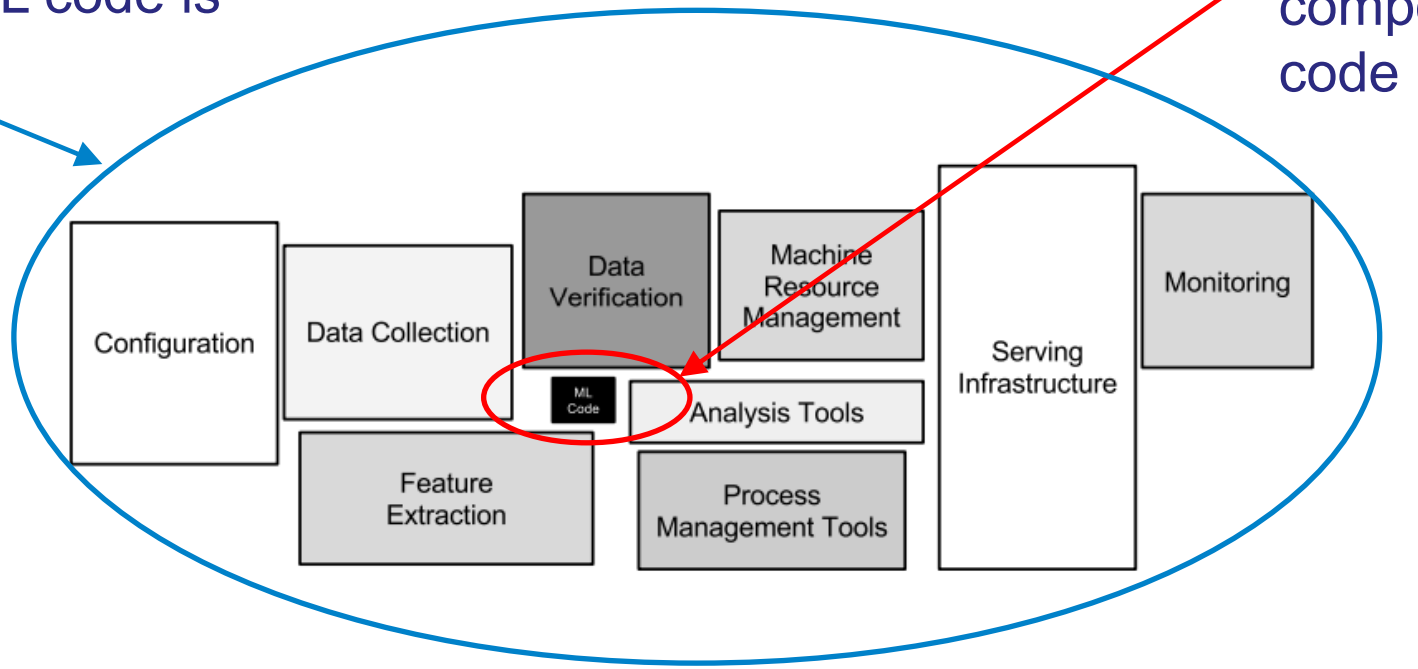
This is an environment that can support the whole end to end process from building to deploying data products into markets



Building a machine learning model

Most of the time, the system surrounding the ML code is repeatable

Only a small fraction of an ML system is composed of the ML code



Hidden Technical Debt in Machine Learning Systems
https://proceedings.neurips.cc/paper/2015/file/86df7dcfd896fcaf2674f757a2463eba-Paper.pdf

Building a machine learning model

- Clean
- Well structured
- Anonymised
- Reliable

- Easily accessible data
- Data exploration tools
- Automated training/retraining
- Model traceability

- Model traceability

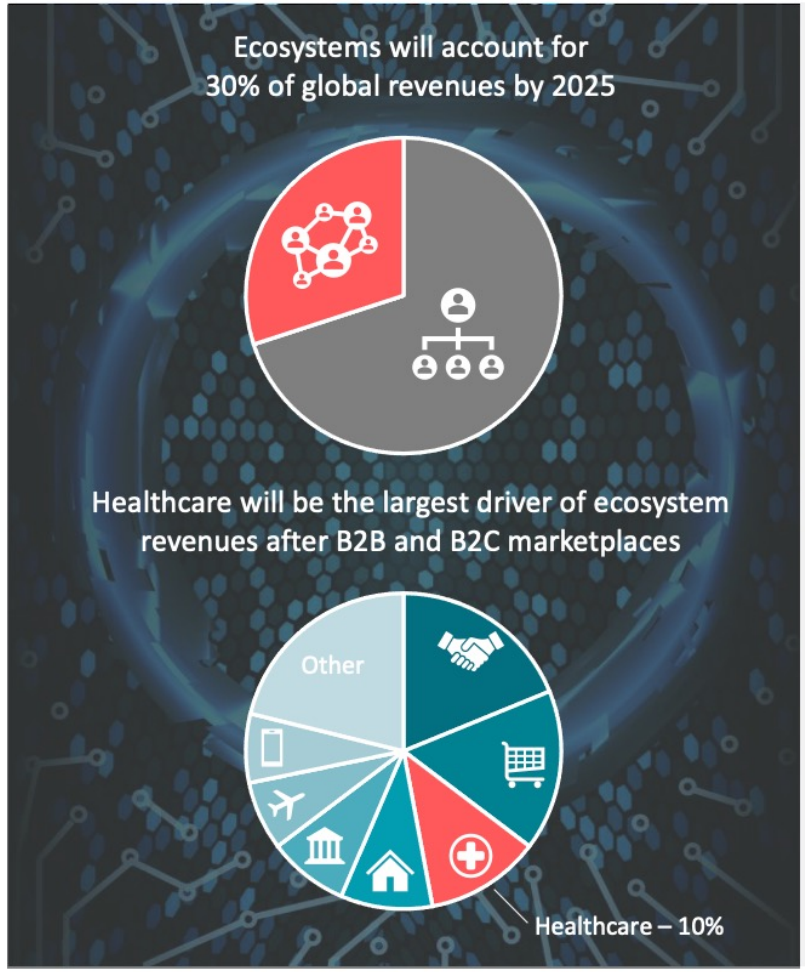
- Automated deployment
- Scalable computation environment

- Machine learning specific monitoring
- System monitoring
- Dashboarding
- Alerting
- Data drift monitoring

The decade of the ecosystem …

How is healthcare faring?

Ecosystem thinking is crucial for future growth in healthcare



01 Seven of the ten **largest companies by market capitalisation** are ecosystem players

02 Ecosystems **create disruptive growth opportunities** with significant revenue potential for ecosystem participants

03 "Sectors without borders" - ecosystems are allowing their organization to **grow in ways otherwise not possible**

04 Ecosystems will **create new competitive advantage**, allowing organisations to use data and analytics to better serve customers

05 Companies need to **increasingly understand how ecosystems will shift value pools** and change the nature of their industry/business

06 The private and digital health ecosystem alone is **estimated to reach $6 trillion** by 2025

It’s easy to confuse ecosystems and platform

The word ‘ecosystem’ is often used to describe a platform, or a platform business, but it’s important to know the difference

PLATFORM BUSINESS

Creates infrastructure that enables service providers and consumers of value to connect and interact with each other

EXAMPLES:

Amazon

Apple

PLATFORM

Allows external service providers and customers to exchange value with each other

EXAMPLES:

AWS

iPhone + App Store

ECOSYSTEM

Network of cross-industry players working together to define, build and execute solutions

EXAMPLES:

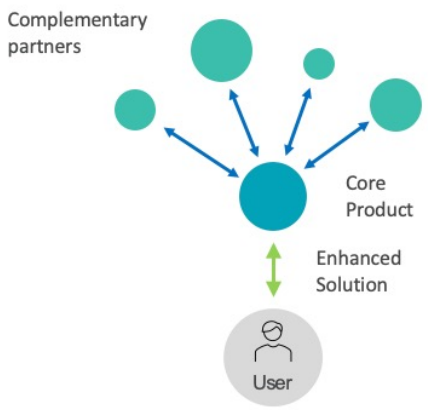
AWS Applications & Services

Apple Developer Ecosystem

Ecosystem archetypes

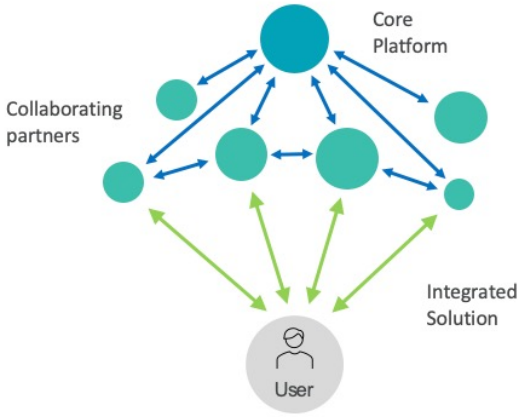
As ecosystems emerge and mature, they tend to take on a set of common characteristics

ENHANCED SOLUTION



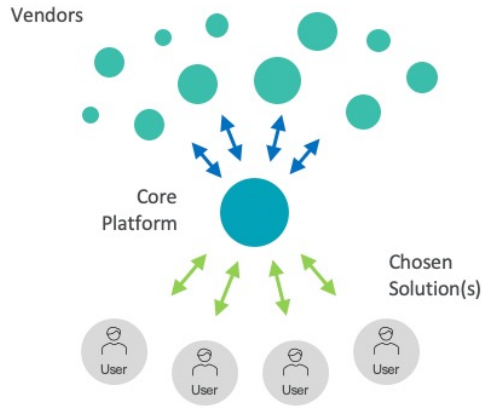
Complementary partners **coming together around a core product** to enhance its function and proposition

INTEGRATED SOLUTION



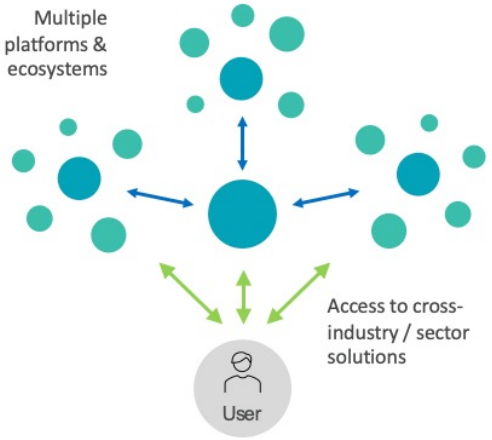
A network of partners with complementary propositions and capabilities **collaborating on a shared platform** to provide an integrated solution

MARKETPLACE



A platform which offers a **shared marketplace for products and services**, facilitating connections between vendors and users

ECOSYSTEM OF ECOSYSTEMS



A cross-sector platform **facilitates connections between ecosystems** to meet adjacent or overlapping customer needs with integrated propositions

alexa TELADOC. Livongo Uber EXPRESS SCRIPTS PINGAN 支付宝 ALIPAY

You don't have to choose just one of these archetypes, and it may be that your ecosystem moves from one to another as it evolves

Examples of ecosystem plays in healthcare

There has been an explosion of healthcare ecosystem plays, accelerated by the pandemic boom in digital care

Single Condition Management

Digital therapies go deep into care for single condition, combining coaching, monitoring and telehealth, commonly for chronic conditions

omada
MAVEN
Hinge Health

$3bn valuation

Digital Formularies

Pharmaceutical giants are building ecosystems for payers, replicating traditional medication formularies for a digital therapeutic world

EXPRESS SCRIPTS
CVS caremark

Convenience Care

Online first platforms provide easy access to care and medication for a range of common conditions (e.g. colds, headaches)

LEMONAID health
pharmacy

$1.5bn valuation

Payer-led

Innovative payers are building marketplaces for digital and physical care, a direct-to-member model to deliver better, cheaper care

athenahealth marketplace
aetna

Comprehensive Care

Multi-condition platforms combine telehealth services with multi-condition care management for true wrap-around digital healthcare

Livongo is now part of Teladoc HEALTH
PING AN

$18.5bn acquisition

Retail+ Healthcare

Big-box retailers are building ecosystems which blur physical and online care, helping consumers access digital services, incl. in-store

20m Users

Walgreens
CVS Health.

This explosion will be followed by **a period of intense competition, partnerships and M&A activity** as the market consolidates and the winners take all

What approach should we be taking in healthcare?

- Orchestration needs to be a conscious choice
- Think big, start small
- Ecosystem strategy and data strategy go together
- Have a common goal and clarity of purpose as you start working with partners
- Invest time in building trust
- Be prepared to move quickly

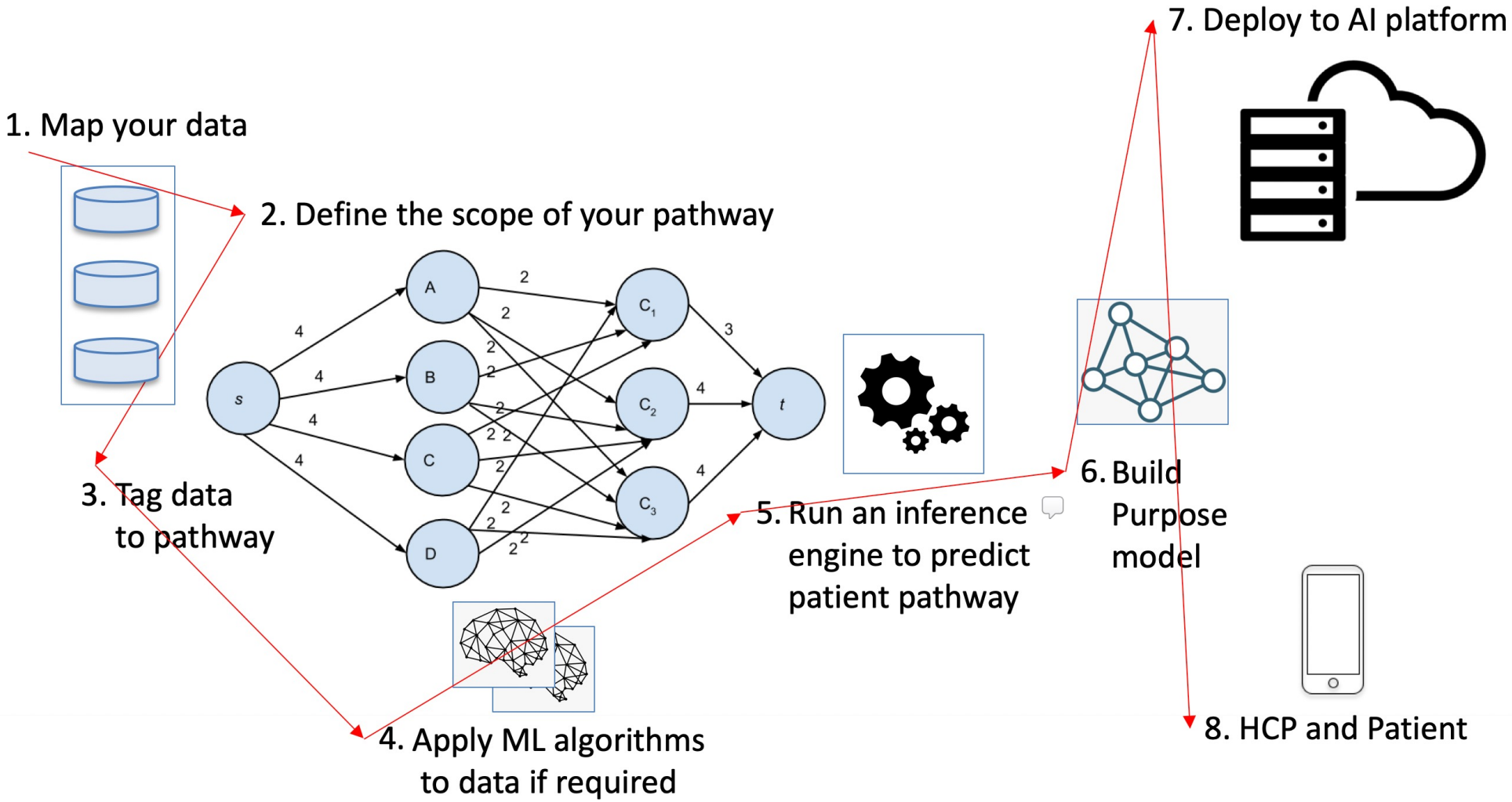
The Data landscape

30% of **ALL** globally stored data is from healthcare and life sciences (Source: Deloitte, MIT Tech review).

So why is building out your data position so hard?

Lessons from McLaren

The economy of applying graph theory



A data centric organisation
Building a data position

- A data strategy aligned to organisational strategic objectives
- Senior buy-in, commitment and sponsorship to drive value from data
- Develop a data driven culture and articulate what the strategy means for each stakeholder
- Identify, engage and co-develop with all key stakeholders
- Actionable implementation plan that is staged to build on foundations and prioritised to include key initiatives

Legislation and Regulation

Establishing ResponsibleAI principles

Strategy

Data & AI Ethics
Consider the moral implication of uses of data and AI and codify them into your organization's values.

Policy & Regulation
Anticipate and understand key public policy and regulatory trends to align compliance processes.

Control

Governance
Enable oversight of systems across the three lines of defense.

Compliance
Comply with regulation, organizational policies, and industry standards.

Risk Management
Expand transitional risk detection and mitigation practices to address risks and harms unique to AI.

Responsible Practices

Interpretability & Explainability
Enable transparent model decision-making.

Sustainability
Minimize negative environmental impact and empower people

Robustness
Enable high performing and reliable systems.

Bias & Fairness
Define and measure fairness and test systems against standards.

Security
Enhance the cybersecurity of systems.

Privacy
Develop systems that preserve data privacy.

Safety
Design and test systems to prevent physical harm.

Core Practices

Problem Formulation
Identify the concrete problem you are solving for and whether it warrants an AI/ML solution.

Standards
Follow industry standards and best practices.

Validation
Evaluate model performance and continue to iterate on design and development to improve metrics.

Monitoring
Implement continuous monitoring to identify drift and risks.

PwC's Responsible AI Toolkit

Policy and legal landscape

- Looking at just the EU

  - EU Data Act - make data accessible to the user or to a user designated third party
  - AI Act - Risked-based regulatory framework for AI (including medical devices with AI component)
  - European Health Data Space – Requirement to share health data in a health data ecosystem

- Navigating global data privacy

  - HIPAA - secure the privacy of personal health information
  - Californian CCPA - consumer rights focus
  - Canadian PIPEDA - consent, transparent policies, limit collection
  - European GDPR - covering consent, data minimisation, individual rights, + stiff penalties
  - ……

- LLM policy and litigation

  - White House executive order - seeks to promote responsible AI safety and security principles and actions with other nations
  - OpenAI fighting numerous lawsuits

Business perspective

Economics of growing a digital health component

- People capital

  - AI products + toolsets always evolving and commoditizing, how do we enable the org?
  - What will organizational competencies be in 2 years, that planning has to start now

- The true cost of development and running AI

  - Cost of acquiring data
  - Model cost in development, test and production

- Building sustainable platforms

  - Large enterprises often lack start-up approach to drive platform development