Building a sustainable data centric strategy in healthcare

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AI’s promise

**Human Intelligence Replicated by Machines**
- An approach to achieve AI, where machine learn the rules

**A technique for implementing ML, powered by large datasets**

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.

**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

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

• 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
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 healthcare than any other industry, with a compound annual growth rate of 85% through 2027, to reach a total market size of $22 billion


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


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

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

Looking at the patient’s data there may be very early indication of ochronotic degenerative arthropathy ….

Early post-op progress indicates that this patient will benefit from the more intense home-based exercise protocol
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:

An LLM model that delivers contained content

Building additional intelligent support into patient engagement, still setting clear clinical boundaries

Offering clinicians and surgeons intelligent clinical assistance, which is assessed before it's application

• 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

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

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

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
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?

3. Early de-risk:
   - Is there a signal?
   - Is it technically viable?

4. Iterative product concept development

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

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.

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

- Seven of the ten largest companies by market capitalisation are ecosystem players
- Ecosystems create disruptive growth opportunities with significant revenue potential for ecosystem participants
- “Sectors without borders” - ecosystems are allowing their organization to grow in ways otherwise not possible
- Ecosystems will create new competitive advantage, allowing organisations to use data and analytics to better serve customers
- Companies need to increasingly understand how ecosystems will shift value pools and change the nature of their industry/business
- 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

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.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Companies</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Single Condition Management</td>
<td>Digital therapies go deep into care for single condition, combining coaching, monitoring and telehealth, commonly for chronic conditions</td>
<td>Omada, Maven, Hinge Health</td>
<td>$3bn</td>
</tr>
<tr>
<td>Convenience Care</td>
<td>Online first platforms provide easy access to care and medication for a range of common conditions (e.g. colds, headaches)</td>
<td>LEMONAID, rox pharmacy, aetna marketplace</td>
<td>$1.5bn</td>
</tr>
<tr>
<td>Comprehensive Care</td>
<td>Multi-condition platforms combine telehealth services with multi-condition care management for true wrap-around digital healthcare</td>
<td>Livongo, Teladoc, Ping An, CVS Health</td>
<td>$18.5bn</td>
</tr>
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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

1. Map your data
2. Define the scope of your pathway
3. Tag data to pathway
4. Apply ML algorithms to data if required
5. Run an inference engine to predict patient pathway
6. Build Purpose model
7. Deploy to AI platform
8. HCP and Patient
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 Responsible AI principles

PwC’s Responsible AI Toolkit

**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.
- **Validation**
  Evaluate model performance and continue to iterate on design and development to improve metrics.
- **Standards**
  Follow industry standards and best practices.
- **Monitoring**
  Implement continuous monitoring to identify drift and risks.
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