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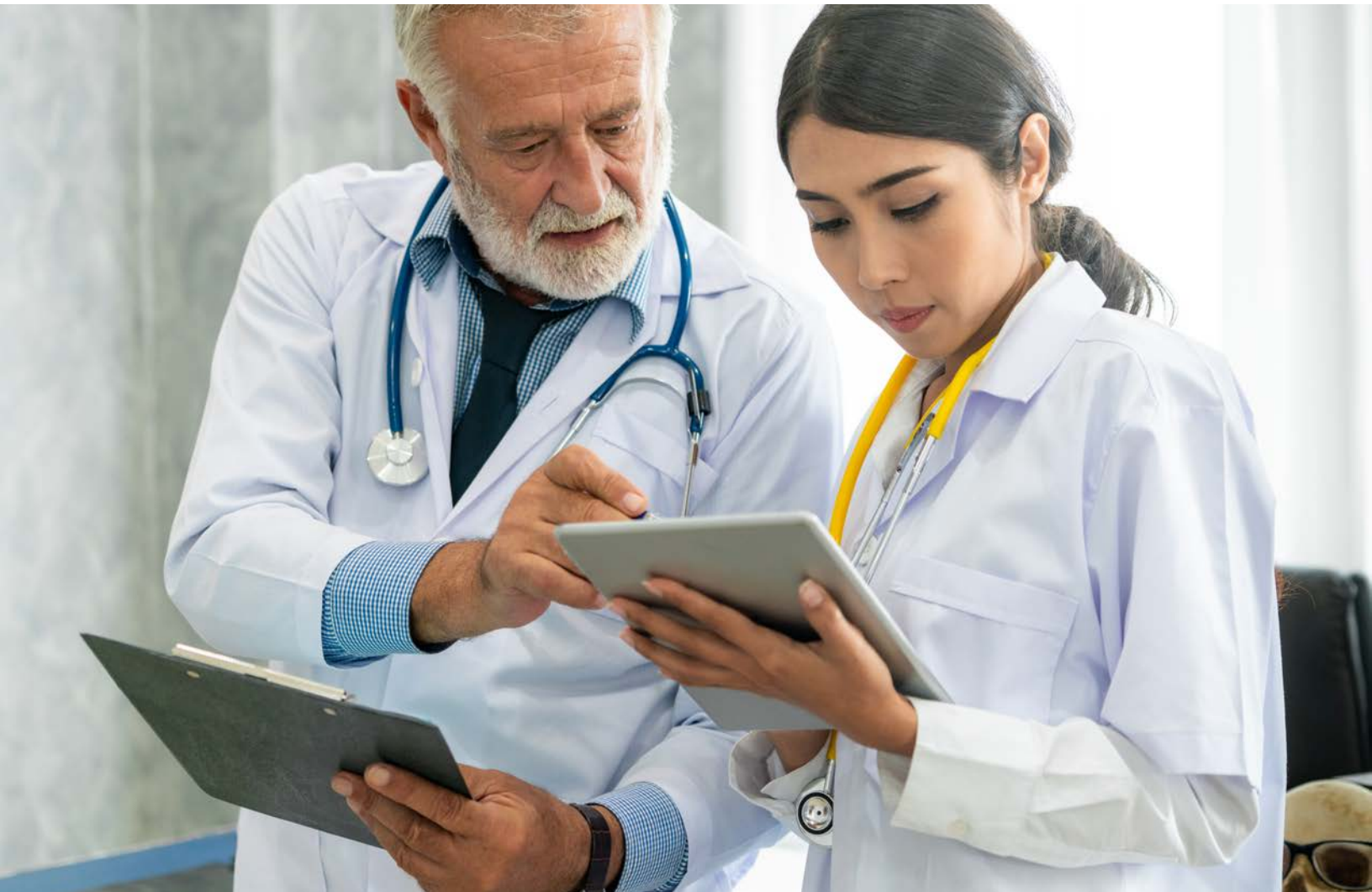
Generative AI in Healthcare and Life Sciences

Prepared by Andy Busam, Dr. Gareth Jones, & Dr. Scott Pope



Introduction

Artificial intelligence (AI) has found broad application in healthcare over the past decade, from aiding in clinical decision support to assisting in robotic surgeries, optimizing workflow, and administrative tasks. While the healthcare industry has already experienced significant impacts from AI, a new sub-discipline will create even greater revolution: generative AI. Generative AI is similar to traditional AI with the added ability to create (i.e. generate) brand new information above and beyond what it is fed.

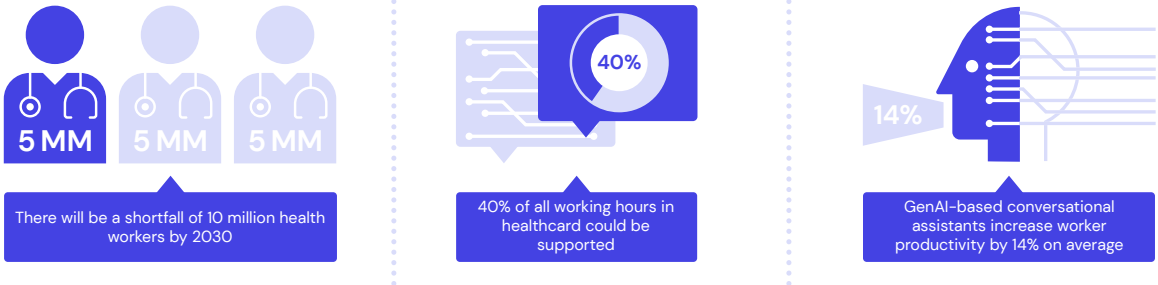
In this paper, we'll share the significant history of AI in healthcare, more clearly differentiate between AI and generative AI, share industry trends for generative AI deployment, describe ways to mitigate its risks, and foster your journey to safely and effectively unleashing this powerhouse technology for your company.

One does not need to look far into healthcare and life sciences to find major problems that need solutions. Preventable medical errors, exorbitant expenses for drug discovery, and a healthcare workforce spread far too thin headline a short but ripe list of opportunities to deploy generative AI. More specifically:

Primary Care: Up to 50% of all medical errors in primary care are due to administrative reasons

Pharmaceuticals: $1.8 billion is the average cost of taking a drug from discovery to market

Healthcare Worker Shortages



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Since generative AI is still new, we've yet to fully understand the risks associated with it. A consortium of AI experts and public figures have issued stark warnings about "important and urgent" AI risks, via a relatively new organization called the Center for AI Safety. Generative AI brings a decidedly untamed feel to the technological landscape, introducing a level of risk that may seem incongruent with the highly regulated healthcare and life sciences space.

Even so, the potential is too great to be ignored. Healthcare providers, hospitals and clinics, clinical researchers, and medical device product developers are already implementing generative AI in numerous ways. This wide range of adoption is driven by generative AI's abilities to reduce costs, improve care, and accelerate time to market. To better understand this current state adoption, it's imperative to start at the beginning.

The History of Machine Learning and AI in Healthcare

The history of machine learning and AI in healthcare are interlinked and, to some, may be surprisingly long. It's important to appreciate this history that led to the current advances in generative AI.

The often 'reticent to change' healthcare industry was actually an early adopter of machine learning and artificial intelligence technologies. At a very high level, the applications of machine learning and artificial intelligence to healthcare can be split into two trenches: diagnostic and administrative.

Diagnostic
As far back as the late 1950s, researchers were experimenting with using computers to process medical data and make diagnostic suggestions. However, the available computing power at the time severely limited the complexity of the algorithms. It wasn't until the 1990s, with the rise of more powerful computers, that machine learning began making real inroads in healthcare. The 2000s then

saw an explosion of interest in applying machine learning in healthcare, thanks to the availability of large datasets, increased computing power with GPUs, and novel neural network architectures. Researchers developed AI systems for automated medical coding, predictive risk modeling, and assisting with clinical decision support. Pharmaceutical companies also began using AI for drug discovery and development.

Researchers have developed computer vision models to analyze clinical images like X-rays, CT scans, and MRI scans to detect potential abnormalities. Utilizing large data sets of labeled medical images these models have been trained to identify visual patterns associated with a range of diseases and conditions such as Coronary artery disease, osteoporosis, and a range of lung diseases. This research and development has been so prolific it has resulted in computer vision models designed specifically for healthcare applications, such as the U-Net.

More traditional machine learning models have been applied to the analysis of a range of biosignals such as blood pressure and flowrate, and brain LFP signals. These methods, along with the utilization of IoT devices, have been shown to have early potential to facilitate remote monitoring of disease.

1986

University of Massachusetts releases DXplain, using inputted symptoms to generate diagnoses for 500 diseases — now expanded to more than 2,600 conditions.

1991

The Pathology Expert Interpretative Reporting System generates pathology reports with nearly 95% diagnostic acuracy.

2007

2007 IBM creates the open-domain question-answering system Watson. In 2011, Watson wins first place on Jeopardy and, in 2017, neurologists use it to identify RNA-binding proteins altered in ALS.

2015

The U-Net is created by Olaf Ronneberger, Philipp Fischer, and Thomas Brox and soon has tens of thousands of citations.

2015

2015 Pharmabot assists in medication education for pediatric patients and caregivers.

2017

Arterys earns Food and Drug Administration (FDA) approval for a product that analyzes heart MRIs in seconds.

2017

2017 Deep-learning applications screen for diseases ranging from diabetic retinopathy to skin cancer with astonishing accuracy. The FDA approves the first AI-powered device for operating-room use.

2019

The FDA approves the first AI-powered device for cancer diagnosis as well as a deep-learning algorithm for interpretation of brain MRIs.

2020

2020 Google DeepMind uses AI to predict a protein's 3D structure from its amino-acid sequence, solving one of biology's greatest challenges.

2022

The FDA authorizes 91 AI-powered devices. One, the EchoGo Heart Failure tool, detects heart failure from a single echocardiogram.

Current state-of-the-art deep learning algorithms can now analyze complex 3D medical images, identify biomarkers for disease, predict clinical outcomes, and generate synthesized data.

Administrative
Much progress has been made in natural language processing for extracting information from medical texts and generating medical reports.

However, most current AI systems still focus on narrow tasks and require human oversight. The next frontier is general-purpose AI systems that can understand patient data at a holistic level, provide explainable inferences, and engage in medical conversations.

Advances in generative models and causal reasoning hold promise for developing more transparent and trustworthy AI to augment clinicians' abilities.

But more research and testing are still required to integrate increasingly powerful generative AI capabilities into real-world clinical workflows. Healthcare AI has come a long way but still has much room left to continue revolutionizing medicine.

From Artificial Intelligence to Generative AI

Traditionally, the value of AI in healthcare drew from two main abilities: automation and high dimensionality. AI has the ability to repeatedly perform tasks that are highly intensive and time-consuming for human professionals, without deviation from a standard methodology. Furthermore, these algorithms are able to analyze information in very high dimensions, whereas human consumers are restricted to low numbers.

These benefits in combination allow AI to make quick work of analyzing massive datasets, spotting anomalies otherwise undetectable to the human. Using algorithms to replicate and then imitate human processes, traditional AI made it possible to streamline workflows and automate tasks required for patient engagement, diagnosis and treatment, clinical research, digital product development, and healthcare administration. AI has assisted healthcare organizations by detecting patterns in data, classifying information, automating repetitive tasks, performing predictive calculations, and more.

The advent of generative AI marks a major shift, as algorithms are now capable of producing new content.

Where traditional AI provided patient data analysis to inform practitioner decisions on diagnosis and treatment, generative AI can interpret those findings and produce images to summarize them, for example.

Generative AI can produce synthetic medical data for clinical trials, optimize designs for 3D printing, automate medical product development documentation, simulate and optimize the supply chain, and a lot more.

Market Opportunities

Generative AI offers several business benefits for healthcare businesses and life sciences companies, including:

Accelerated Innovation
By automating complex tasks and generating new insights, generative AI enables organizations to bring new products and solutions to market faster.

Reduced Costs
A life sciences specific example is evident in drug discovery, where generative AI models can help identify potential drug candidates more efficiently, reducing the time and resources required for traditional screening processes. Another broader example is the use of AI-powered virtual assistants and chatbots to handle a significant volume of patient inquiries, reducing the need for human resources.

Enhanced Decision-Making
Thanks to the valuable insights and recommendations made possible by analyzing large amounts of data and generating predictive models.

Personalized Healthcare Services
By analyzing patient data and generating tailored recommendations, this level of personalization can lead to better patient engagement, increased patient satisfaction, and improved patient outcomes. Healthcare businesses that offer personalized services are more likely to attract and retain patients and gain a competitive advantage.

Improved Supply Chains
Benefitting healthcare and life sciences industries alike, generative AI can analyze supply chain data, predict demand, optimize inventory management, and enhance logistics to improve efficiency, reduce waste, and ensure the availability of critical resources when needed.

Fraud Detection and Prevention
An area of significant challenge that results in financial losses and compromised patient safety. Generative AI can help identify patterns of fraudulent activities by analyzing large volumes of healthcare claims, billing data, and patient records. This enables early detection and prevention of fraudulent practices, reducing financial losses and protecting the integrity of healthcare systems.

Improved Compliance and Risk Management
By automating compliance monitoring, analyzing vast amounts of regulatory information, and identifying potential risks or violations.

Precision Marketing and Targeted Interventions
To analyze patient characteristics, demographics, and health records to generate targeted strategies that improve both marketing results and patient outcomes.

Collaboration and Knowledge Sharing
By analyzing research papers, clinical guidelines, and patient data to generate insights and recommendations for researchers, healthcare professionals, and policymakers.

It's important to note the successful implementation of generative AI requires careful planning, investment in infrastructure, and collaboration between technology teams and domain experts. However, the potential business benefits of generative AI in healthcare and life sciences make it an attractive investment for organizations in these industries when risks are mitigated.

Generative AI: Examples in the Market

There are many examples of generative AI already in the market today. For example, Abridge AI uses ambient audio recording to transcribe doctor-patient

interactions, summarize the conversations, generate care plans, and share a version directly to patients via a mobile app. They have recently completed integrations with the major electronic health records (EHRs), Epic and Cerner. Using Natural Language Processing (NLP) in this context is almost a no brainer. It makes the physicians more efficient and allows them to focus on the patient over taking notes. And, it creates a transparent feedback loop to patients to help with adherence to treatment protocols and prescriptions.

Syntegra applies generative AI models to real-life patient data to create synthetic data sets. While the data is representative of actual patient populations, it is all anonymous and de-identified to ensure privacy. A wide range of healthcare companies are using Syntegra datasets including R&D teams in the life sciences space to speed up drug development. It's also being used by health systems and payers to create better value-based care programs.

Epic and Microsoft inked a partnership this past April to begin piloting OpenAI's GPT-4 integrated into complex workflows and clinical decision support systems. They plan to use it to analyze patient records and interactions to provide better treatment recommendations to patients. And more recently, Microsoft subsidiary Nuance has partnered with Epic to integrate their ambient audio recording technology to capture doctor-patient conversations. This will clearly challenge a start-up like Abridge.

Organizations struggle to innovate quickly and move on these opportunities while mitigating risk and meeting their regulatory requirements. Technology companies see this as an opportunity to leverage generative AI.

Google Cloud and the Mayo Clinic announced a generative AI partnership, for example, that gives the clinic access to groundbreaking tools like Google's Gen App Builder. It's an enterprise tool for generating custom, low-code chatbots and enterprise search solutions, enabling the healthcare organization to apply the power of Google's search algorithms to its own datasets.

Generative AI: Challenges & Limitations

Despite these successful case studies, generative AI is not without its risks and limitations, especially when it comes to healthcare and life sciences.

Decisions around human-AI collaboration and decision-making are among the most common challenges right now, as the technology is still so new that best practices are not yet established. We believe generative AI should be viewed as a tool to assist human decision-making, rather than replacing healthcare professionals, and so a human should always remain in the loop. Over-reliance on AI-generated outputs without proper human oversight and critical evaluation can lead to errors, misdiagnoses, or inappropriate treatments. Balancing the roles of AI and human expertise is crucial to mitigate this risk. The aim of generative AI, afterall, is to reduce and optimize human workload, and so balancing this efficient increase while maintaining human oversight is a difficult balance to strike.

Here are several other challenges and limitations to account for in planning generative AI implementations in healthcare and life sciences:

Ethical Concerns:
When thinking about the introduction of any new tool to healthcare, however particular one as impactful as generative AI, careful consideration must be given to the impact on both clinical staff and patients. We must consider patients' sentiment to their sensitive data being processed by algorithms, clinicians requests around accountability and liability, concerns around trust and transparency, among other ethical concerns. Ensuring fairness, transparency, and accountability in AI algorithms is crucial to mitigate these ethical concerns.

Data Privacy and Security:
Generative AI relies on large amounts of sensitive patient data, and the collection, storage, and analysis of this data raise concerns about data privacy

and security. Mishandling or unauthorized access to patient data can result in privacy breaches and compromise patient confidentiality. Robust data protection measures, encryption, and compliance with data privacy regulations are essential to mitigate these risks. Furthermore, generative AI is trained to learn and then replicate complex patterns and behaviors in datasets. This raises the low, however not impossible, risk that these models leak personal or sensitive information.

Lack of Explainability:
Generative AI models are often complex and opaque, making it challenging to explain their decision-making processes. This lack of explainability can lead to a loss of trust among healthcare professionals, patients, and regulatory bodies. Trust is particularly important in healthcare due to the high risk decisions made, and so must be maintained. Efforts to develop explainable AI models and techniques that provide transparency into the AI-generated outputs are essential to address this risk.

Legal and Regulatory Compliance:
Generative AI in healthcare and life sciences must adhere to legal and regulatory requirements. Compliance with regulations such as HIPAA (Health Insurance Portability and Accountability Act), GDPR (General Data Protection Regulation), and FDA (Food and Drug Administration) guidelines is crucial. Failure to comply with these regulations can result in legal and financial consequences for organizations.

Limited Generalizability:
Generative AI models are trained on specific datasets and may struggle to generalize to different populations or contexts. This can lead to models inadvertently introducing biases or reinforcing existing biases present in the training data, leading to discriminatory or unfair outcomes in healthcare decision-making, treatment recommendations, or resource allocation. This limitation can impact the accuracy and reliability of AI-generated outputs when applied to diverse patient populations or novel scenarios. Ensuring robust validation and testing processes that encompass a wide range of data and use

cases is essential to address this risk.

Dependence on Quality and Representativeness of Data:
There's an old saying in the computing world, "Garbage In, Garbage Out." This principle couldn't be more true with the advent of generative AI. The performance and reliability of models heavily rely on the quality, diversity, and representativeness of the training data. Biased, incomplete, or unrepresentative datasets can lead to skewed or inaccurate AI-generated outputs. Careful attention must be given to data collection, curation, and ongoing monitoring to ensure high-quality and unbiased training data.

Naturally, there is not a singular way to address these numerous risks. Instead, you must explore each with consideration for the nuances and caveats of your use case and problem to be solved. This can require stakeholder interviews, desk research, and system and data mapping. Working with a proven innovation partner, who has experience in navigating this discovery, helps ensure these risks are managed and that prospective digital solutions are thoroughly tested and meet the regulatory, business, and consumer expectations required to perform in the market.

Our Perspective

Fall in Love with the Problem
At Method we take a user first, problem centric approach to everything we tackle. While we believe generative AI possesses significant potential for healthcare and life sciences, it is one of the many tools we have available to use in our arsenal. As the old saying goes, if the only tool you have is a hammer, it is tempting to treat everything as if it were a nail. We begin every engagement with a comprehensive discovery phase, allowing us to fully understand the problem that

must be solved, the needs of the stakeholders, and the nuances of the business we are working within. We then define the best possible solution to this problem.

Elevate Human Capacity, Don't Replace It

We believe AI and machine learning technologies should enhance and streamline people's lives, not replace human roles and responsibilities. By including stakeholders and users from the earliest points of our discovery phase, we give users meaningful control over when and how generative AI features are applied in their healthcare and life sciences roles. The technology should fit seamlessly into existing workflows, not introduce disruptive new paradigms. Ensuring we meet users where they are builds trust and better utilization of the products produced.

As stated, for healthcare generative AI has the potential to remove low risk and mundane activities from clinician workloads. This allows for time, effort, and resources to be prioritized to the most impactful and meaningful cases. In turn, this is expected to improve both quality and scale while reducing overall costs. With this belief we take a measured, pragmatic approach focused on augmenting human capabilities rather than pursuing automation for its own sake.

Transparency is Imperative

Our design philosophy is that AI should operate transparently, with clear explanations of its capabilities, limitations, and source data utilized. This element is perhaps more critical in healthcare and life sciences than in any other industry due to the consequential magnitude of poorly informed decisions. With machine learning and AI, transparency is key, but it takes on a heightened imperative when generative AI is creating de novo information.

Reliable, Repeatable, and Predictable

When assessing the performance of generative AI models it is important to ensure excessive automation does not undermine human judgment or learning. We look for indications that the systems perform reliably and predictably. We work to maximize transparency, providing users with visibility into how the systems work behind the scenes. And we track metrics beyond accuracy, prioritizing user satisfaction, trust, and adoption.

Human-centric Collaboration
Ultimately, we see generative AI as a collaborative tool, not a replacement for human ingenuity. Thoughtfully designed generative capabilities present new creative opportunities to improve the entire healthcare ecosystem. But the human perspective must remain at the center, steering AI toward benevolent, life-enhancing outcomes. This pragmatic human-centric approach guides our process as we explore integrating leading-edge generative AI into innovative new products and services for healthcare and life sciences companies around the globe.

Conclusion

The possibilities for generative AI in healthcare and life sciences, especially in digital product development, are vast and promising. The integration of generative AI holds tremendous potential to revolutionize these industries, enabling advancements that were once unimaginable. By harnessing the power of AI to analyze complex data, generate novel insights, and enhance decision-making, healthcare businesses and life sciences companies can unlock numerous benefits.

Generative AI has the capacity to accelerate innovation, streamline processes, and reduce costs, resulting in improved operational efficiency and competitive advantage. The ability to personalize treatment plans, optimize drug discovery, and enhance medical imaging can lead to better patient outcomes and a more patient-centric approach to healthcare. Furthermore, generative AI-driven digital products can empower healthcare professionals, researchers, and patients by providing them with valuable tools, insights, and support.

While navigating the implementation of generative AI, it is crucial to address

ethical considerations, privacy concerns, and regulatory compliance. By prioritizing fairness, transparency, and accountability, organizations can build trust, ensure patient privacy, and adhere to legal and ethical standards. As we move forward, the collaboration between medtech engineers, data scientists, healthcare professionals, technology ethicists, and regulatory experts will play a vital role in harnessing the full potential of generative AI.

Together, we can develop innovative solutions that improve patient care, accelerate scientific discoveries, and transform the landscape of healthcare and life sciences.

Embracing generative AI represents a significant step towards a future where healthcare is more precise, accessible, and personalized. By deploying generative AI in responsible and ethical ways, we have the opportunity to shape a world where technology augments human expertise, leading to better healthcare outcomes and ultimately improving the quality of life for individuals around the globe.

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Partnering with Method

Invest a Day: Developing Your AI Strategy

Starting with the end in mind is essential to incorporating generative AI in your healthcare products and services. Thoughtfully evolving your strategies, objectives, and frameworks is a great first step for even the most mature of companies. Our interactive generative AI workshop provides your team an immersive education into the capabilities and applications of this transformative technology. Through demonstrations, use case reviews, and whiteboard brainstorming, we will guide you in identifying where generative AI can drive the most value for your business.

Invest a Month: Appreciating Your AI Readiness

With a well-thought out strategy in hand, it's critical to assess your organization's ability to adopt and leverage generative AI. Appreciating your unique business goals, assessing risks and rewards, and evaluating your current product maturity will inform the ideal ways to implement and optimize generative AI in your organization. Our unbiased advisory services, powered by our team's deep expertise in AI, provide thorough recommendations and strategies for implementation.

Invest 2-3 Months: Using AI to Solve Your Customers' Problems

You know the complete picture requires envisioning innovative applications of generative models, validating product-market fit, outlining user experiences, and spearheading go-to-market plans. We help you employ human-centered design to fully understand your users and their needs. We ideate and prototype generative AI product features optimized for usability, adoption, and retention. We validate our experience designs through user research to maximize usefulness and usability for your generative offerings. From design systems to accessible interactions, we create end-to-end experiences that turn first-time users into loyal brand advocates.

We ensure every product and service powered by generative AI provides compelling value to attract and retain customers.

Connect

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