AI Transformation
Healthcare
What Does ChatGPT Mean for Healthcare?

**AI Transformation is the New Digital Transformation**

Digital transformation began in the late 1990s and early 2000s as companies started to modernize by integrating new technology into their core operations. For many healthcare companies, this journey started with implementing electronic health record systems, and ranged to, in later years, adopting telehealth technology during the pandemic. Technologies such as these radically transformed the way healthcare companies do business, with effects lasting into the present day.

We stand at a similar exciting precipice right now in which AI transformation is the new digital transformation. With the explosion of ChatGPT and similar technologies, it is clear that every company needs to be an AI-first company in a future where the cost of intelligence trends toward zero. However, many Fortune 500 companies have foundational data, application, and infrastructure work to be done first. Companies need to acquire technical AI expertise and ensure the right data architecture and cloud infrastructure are in place to take full advantage of the massive opportunities ahead. While AI promises to bring benefits across many industries, the opportunities in healthcare are as manifold as in the days of digital transformation, ranging from improving diagnosis and patient experience to automating back-office administrative tasks. Medical centers like Mayo Clinic and Cedars–Sinai are already seeing the benefits of early AI implementation.

This paper aims to discuss the evolution of AI and how it will revolutionize healthcare, as well as share important advice on how to be poised to leverage this technology in your business. It is drafted by leading AI experts at Turing, a technology services company that stands at the forefront of the AI transformation and partners with clients to help them remain competitive in this new technological era.

**The ChatGPT Moment: The Evolution of AI**

- **1943**
  - "A Logical Calculus of the Ideas Immanent in Nervous Activity" - mathematical model of an artificial neuron by McCulloch & Pitts.

- **1950**
  - Turing Test.

- **1970s – 1980s**
  - Rule-based expert systems / knowledge-based systems era: researchers started to develop neural nets for computers to mimic how humans process data.

- **1980s**
  - CNNs (Convolutional Neural Networks) – neural network particularly useful for image & video recognition, as well as applied to speech and text processing. Note: this gained widespread popularity in late 2000s with advent of deep learning.
  - Late 1980s - early 1990s: Machine Learning era

- **1997**
  - LSTMs (Long Short Term Memory networks) – state of the art neural network precursor to transformers, introduced by Hochreiter and Schmidhuber.

- **1997**
  - AlexNet / ImageNet – jump in computer vision improvements.

- **2012**
  - Attention is All You Need – Transformers paper by Google Brain team – reduced training time while improving model accuracy.

- **2017**
  - DALL-E - language-based image generative model launched.

- **2021**
  - ChatGPT – generative model for chatbot with natural language.
Current Applications of AI in Healthcare

For many, the top-of-mind question is: how will ChatGPT impact my company? For businesses operating in the healthcare industry, the applications and benefits are numerous.

As healthcare data becomes more complex and abundant, AI is being deployed at every stage of patient care by payers, providers, and life sciences companies. The principal categories of AI applications currently in use include:

- suggesting diagnosis and treatment options
- increasing patient engagement to ensure adherence to treatment plans
- streamlining administrative and insurance-related tasks to improve productivity

**Suggesting diagnosis and treatment options:** Advancements in imaging technology hardware and software have expanded the diagnostic capabilities of clinicians, reducing their reliance on invasive exploratory procedures such as biopsies and surgeries. However, these very same innovations have also caused a significant surge in the workload of radiology departments. Studies have shown that AI can streamline this workload by reducing overall interpretation time by 27% while increasing accuracy by 5.6%. [1]

Here are a few additional examples of diagnostic benefits. In a recent drug identification for cancer treatment, the Medical University of Vienna in Austria tested a new matchmaking technology that utilized robotic automation and computer vision (machine-learning models trained to identify small changes in cells) to identify the right drug combination for trial patients. The discovery was done in a significantly short period of time rather than after years of trial and error. [2] Similarly, the Department of Veterans Affairs and DeepMind Health collaborated on a model that can predict the presence of an acute kidney injury up to 48 hours faster, enabling doctors to intervene and prevent serious long-term complications including the need for dialysis. [3] More such use cases have been recorded for bone fracture accuracy improvement and breast cancer detection improvement. The machine learning (ML) models in each of these cases have developed a high level of accuracy to reduce false positives and negatives.

**Improving patient engagement:** Patients today expect hospitals and healthcare providers to engage with them in a variety of ways that go beyond traditional medical care. Some of the key patient expectations from an engagement perspective include:

- communicating with them in a clear and timely manner
- personalizing their care experiences and making healthcare services more convenient
- providing education and resources that help them take an active role in their own care

Numerous hospitals and healthcare organizations have implemented AI-based chatbots to engage patients to enhance the patient experience.

- **Cleveland Clinic:** Cleveland Clinic developed an intelligent chatbot called "Ask Eva" to help patients schedule appointments, answer health-related questions, and provide personalized health advice. The benefits of the chatbot include increased patient engagement, improved efficiency in appointment scheduling, and reduced wait times.
- **Mayo Clinic:** Mayo Clinic implemented a chatbot called "Mayo Answers" to provide patients with quick and easy access to healthcare information. The chatbot improved satisfaction and enhanced education.
Streamlining administrative tasks: According to a study by the American Medical Association, physicians in the United States spend an average of 16–17% of their time on administrative tasks. And according to a study published in the *Journal of General Internal Medicine*, nurses spend about 25% of their work time on documentation and administrative tasks. One current challenge is coding accuracy for billing—according to the Centers for Medicare & Medicaid Services, coding errors resulted in $31.46 billion in improper payments in FY 2022 [4].

Several healthcare providers are using AI-based systems for automating administrative tasks such as appointment scheduling, inventory management, and for billing and revenue management.

- **Northwell Health**: This New York–based healthcare provider implemented an AI-powered chatbot to help patients schedule appointments, access medical records, and get answers to common questions.
- **Cedars-Sinai Medical Center in Los Angeles** has implemented an AI-powered revenue cycle management system that uses predictive analytics to improve billing accuracy and speed up reimbursement processes.
- **UCLA Health** has implemented an AI-powered system to automate the coding of medical records, reducing errors and improving billing accuracy.

Additionally, AI can support hospital operational management, optimizing their capacity and throughput.

These are just a handful of the current healthcare applications of AI—many more exist and promise to deliver immense business value to those that employ them.

**How to Build AI into Your Healthcare Company**

Given the clear value of AI in healthcare, we outline some important steps for making the AI transformation in your business a reality.

**Assessment**: The first step is understanding the most important priorities in your business and then determining whether AI is suited to deliver transformative impact for those priorities or focus areas. Oftentimes, the foundational piece is having the right data infrastructure to support analytics and data science before moving to AI. This is important when, for instance, building predictive models for patient diseases or assessing claims validity.

**Planning**: The next component is deeply understanding what needs to be built and how to measure success.

We have found the following questions to be most valuable for planning:

1. How do we measure the impacts of this transformation? Is the success measurement aligned with the business priority and patient outcomes?
2. What datasets do we have, and what datasets should we collect? What is the quality of the datasets? Is the data structured in a reasonable way? What privacy and security concerns should we have for the data, especially when handling patient information?
3. What is the right ML model to start with for the prioritized usage cases and the datasets? How important is explainability, or demonstration that the model is not subject to certain types of bias?
4. What is the team’s operational model? Is it agile enough to allow iteration of the solutions based on business outcomes and customer feedback? Is the business problem one that’s suited to rapid iteration, or are there regulatory or other limitations on iteration once the model is in production?
Execution: The final piece is to bring your plan to execution. We break down the lessons and best practices we have learned into these four key aspects:

1. **Measurement of success**: This is seemingly straightforward but in practice needs careful understanding of the relationship between business metrics and technical metrics. Ideally, the technical success metrics should lead to long-term business success, but we often see common misalignments like:
   a. Minimizing personnel time spent on administrative tasks, but not accounting for time spent correcting errors at the accuracy level the model can provide
   b. Optimizing for ease of rescheduling but not seeing the patient at recommended regular intervals

2. **Dataset**: Teams that are new to AI transformation often overlook the foundational part—their datasets. An AI model is fundamentally a function that transforms input data into more valuable output data. So, if the input data is not of the quality and quantity needed, we have the effect of garbage in, garbage out. When looking at the dataset, we need to focus on:
   a. Quality: This pertains to the quality of the signal or information carried in the data. Especially key is the robustness of engineering systems that affect consistency and the availability of data. Some challenges unique to the industry are:
      i. Electronic health records (EHRs) are not standardized across the industry, leading to difficulties combining datasets from diverse sources. Individual records may have complicated structures or lack structure entirely, especially if they are processed from scanned physical documents.
      ii. Data transfers themselves may be problematic, depending on the architecture and interoperability of systems generating data with those that need to perform modeling tasks.
      iii. Outputs from DICOM devices are not consistent. Each manufacturer has its own specification and proprietary tools to interpret their images.
   b. Quantity: In addition to quality, the quantity of data is important for making reliable inferences and separating signal from noise.
   c. Implications for privacy, transparency and security: Healthcare organizations handle sensitive patient data, and AI systems need to be designed with data privacy and security in mind. To comply with HIPAA regulations, healthcare organizations need to ensure that patient data is properly de-identified to protect patient privacy and that patients are informed about data usage.

3. **Select the right ML models**: Popularity of large language models skyrocketed recently due to the initial success of ChatGPT. However, when looking at a specific business problem, the larger models are not necessarily better. Look at different options in the following table while considering the nature of the job (different jobs have different SOTA models), the dataset quality and availability, the cost of training and serving, and the talent in your team. Some healthcare applications may also require model explainability and demonstration of fairness (e.g., those making clinical recommendations).
<table>
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<tr>
<th>Incomplete List of Options</th>
<th>Example Jobs</th>
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| **Direct using pre-trained large model** | - Bot for day-to-day conversation (w/ GPT).  
- Example Use Cases: Scanning paper medical forms into digital formats, language translation services for patients, image art generation (w/stability.ai) |
| Required Data | Cost of Training and Serving | Talent Required | Leveraging Future SOTA | Explainability |
| Minimal | Minimal & fast | Low | Easy | Low |
| **Using pre-trained large model with customized contexts (a.k.a prompt eng)** | - Personalized chatbot for conversation tailored to specific use cases, with requirements for tone or type of support/information provided.  
- Symptom and emerging disease classification |
| Required Data | Cost of Training and Serving | Talent Required | Leveraging Future SOTA | Explainability |
| Small | Small & fast | Medium | Easy | Low |
| **Building your own (smaller) models for your usage case** | - Detection of specific health conditions |
| Required Data | Cost of Training and Serving | Talent Required | Leveraging Future SOTA | Explainability |
| Large | Large-high & slower depending on the models | ML specialist | Hardest | Depends—rule-based would be highest; Deep Learning-based would be low |
| **Tune the pre-trained models** | - Predicting hospital readmissions by re-training Google’s BERT model (ClinicalBERT [5])  
- Predicting disease by re-training Google’s BERT model (MedBERT [6]) |
| Required Data | Cost of Training and Serving | Talent Required | Leveraging Future SOTA | Explainability |
| Large | Very high & slow | ML experts in large model | Harder | Low |

4. **Building the agile and iterative operation muscle in your team:** Going through the AI transformation will take large investments over a long period of time with many technological breakthroughs that we cannot fully predict. The more iterative your team is, the higher chance you can succeed on such a journey.

   a. Build a team culture of iteration. For an AI initiative, break down the business and technical reasonings into multiple assumptions or hypotheses so that you can get early, quick feedback for the initiative.

   b. Find the quickest way to validate or invalidate the key hypothesis as early as possible. For example, if a hypothesis is that a particular signal will improve the ML model, can you quickly test the model performance before waiting to launch to production?

   c. Build a process that can iterate very fast. An operating model with 6-month to hire + monthly iteration would be much slower than a model with 2-week to hire + daily iteration.

   d. Pay attention to the operation. Launching a new model is the beginning of a long journey. Business metrics could evolve, data could be polluted, and models could drift. It’s necessary to set up monitoring and alert processes to identify these changes and provide feedback for the metrics, data, and models in a structured way.

Getting these four key areas right requires careful strategic decisions on the executive level. There are investment tradeoffs among these areas, such as how much time to invest in getting the right data versus experimenting with different ML approaches. Turing can help you to think through these strategic decisions and tradeoffs.
Getting these key areas right also requires very strong execution in terms of both speed and quality. Turing can help with the know-how of building the data and ML assets and also empower you to get onto a very fast iterative model.

**Future of AI in Healthcare**

Our belief is that AI will play a crucial role in the future of healthcare. The advances in machine learning and natural language processing will have a continued impact on the above-mentioned areas of healthcare functions. Most notably we believe:

- The swift advancements in AI for imaging analysis suggest that machines will likely examine most radiology and pathology images at some point.
- Advances in ML will enable diagnosis and treatment recommendations for certain categories of treatments.
- Advances in deep learning, ubiquity of wearable devices, application of natural language processing, and generative technology will enable the movement from in-hospital care to remote, home-based care.
- AI automation and AI-based drug discovery will streamline precision medicine development.
- AI-based virtual chatbots and process automation have the potential to minimize the duration devoted to administrative duties and empower people to concentrate on more demanding, engaging, and meaningful responsibilities.

Businesses that actively embrace AI adoption are poised to reap immediate benefits by reducing costs and gaining a competitive edge. Over the long run, they stand to leverage AI to revamp their offerings and services, thereby enhancing customer engagement and solidifying their competitive standing.

Turing can help build AI into your business. Learn more about our offerings at [Turing.com](http://Turing.com). Our current healthcare clients include:

![VillageMD](image)

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Thank you