The Use and Ethics of Artificial Intelligence in Healthcare
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The adoption of *artificial intelligence* (AI) in healthcare is on the rise and assisting in solving a variety of problems for patients and providers. Forbes has reported a 14x increase in artificial intelligence start-ups since the year 2000, with investment in the industry up six-fold, topping out at over $3 billion.¹ The following pages will explore the current uses of AI, from listening devices and web applications, to facial recognition and its use in the exam room, as well as touching on a few of the many ethical questions that arise from the use of AI in healthcare. (Note: The scope of this paper is not to address ethical questions concerning AI in healthcare in depth but to identify some of the issues that are presenting and must be studied.) Lastly, we will consider how to establish a strategy for implementing AI in your own organization.
What is artificial intelligence?
The essential requirement of AI is intelligence, defined as the ability to acquire and apply knowledge and skills. It is the capacity to interact (speech, vision, motion, manipulation), reason, learn, adapt, and think abstractly as measured by objective criteria, such as test taking.

The term artificial intelligence is an umbrella term for machines capable of perception, logic, and learning. Today, there are two types of AI:

1. **Machine learning** employs algorithms that learn from data to make predictions or decisions; as the machine’s exposure to data increases, the performance capabilities are improved. In some cases, this may be a simple “if, and, do what” programming logic (see Exhibit I).

2. **Deep learning** uses many-layered neural networks (computer systems based on the human brain and nervous system) to build algorithms that find the most efficient ways to perform a task based on vast sets of data. Deep learning will typically improve over time by adding all past outcomes to the logic for future decisions (see Exhibit II).
While we do not see AI taking the place of all humans, the ethics and risks of machine involvement in patient care over traditional methods have yet to catch up to the technology. More concerning is the overall impact on our society and the shifts in inequalities that AI is expected to cause. Specifically, AI is expected to eliminate 40% of all repetitive jobs over the next 20 years. Examples include call centers, patient check-in, registration, triage, collections, accounts receivable (AR) follow-up, and campus delivery services.

In March of 2019, UPS launched a new service using drones to transport blood and other medical supplies between the various buildings at the WakeMed Health and Hospitals medical campus in Raleigh, NC. The speed at which the drones delivered the samples was significantly faster compared to humans, which in this case could mean the difference between life and death. While this use of AI is a positive factor, the initiative instantly eliminated several courier jobs on campus. A few drone developer jobs were created, but the ratio of jobs eliminated to jobs created was far greater. However, expanded technology in any industry can be expected to create similar repercussions. This should not be seen as a deterrent from continuing the use of AI in the healthcare industry, as the benefits and capabilities of the technology have only begun to be seen.
Spies among us
As we look into the future of AI, consider this scenario:

While your physician is treating you, an AI listening device in the exam room makes thousands of calculations and predictions based on the conversation it picks up between you and the physician. After the exam, the AI device may support the physician’s decision making and/or triggering additional action items, such as ordering the test the physician discussed with you. The AI may also warn the physician of a drug-to-drug interaction because the AI device already knows what you have purchased over the counter, though you have forgotten to mention it to your physician. Did you know fish oil can be an anti-clotting agent and may negatively affect some treatment plans? Further, the AI already knows you just booked a trip to South America, so it triggers a reminder for travel shots. The possibilities are endless.

Google reports that it already has access to 70% of our credit card transactions.¹ Because of this, the AI listening device in the exam room (provided by Google or Amazon) can be linked to the Google database of prior transactions allowing the real-time conversation with the provider to be reconciled with other key data elements that impact your care. Does this make you feel a little creepy? A bit nervous about data being picked up? Does it make you feel more confident knowing that a second set of ears, albeit electronic ears, is helping with decisions? What about all the genetic testing activities that are frequently and widely advertised? What if this data is combined with AI software to achieve a better understanding of past medical history from little-known relatives? The truth is, this scenario is already happening all around us.
AI based on crowdsourcing data and/or accessing existing databases is constantly being utilized all around us:

Most everyone has used GPS apps such as Google Maps or Waze. Have you ever seen the apps make real-time suggestions, such as offer new routes, based on a set of circumstances like road construction or a traffic jam?

Do you ever notice how Facebook and other social media apps seem to know your hobbies, travel preferences, and even political affiliations and will make recommendations based on these preferences?

Have you seen an ad pop up in your news feed after visiting a new place or restaurant, even though you did not disclose your location?
Many data collection agencies sell our data, and we often unknowingly release our data on many of the social media and web-based platforms we regularly visit, such as Facebook, Twitter, Google, and Amazon. These companies can see many of the pages you and others are visiting by using hidden tracking technologies, allowing them to tailor their ads accordingly. Another concern that arises is the potential for companies to eavesdrop on phone conversations. While tech companies deny our phones are listening, devices like Amazon Echo, Alexa and Google Home are becoming increasingly popular. These devices do listen, albeit with the consent of the device’s owner.

We give up a lot of data in exchange for these technology benefits, and unknowingly consent to giving up this data when we agree to use third-party apps or social medical platforms. Most people never read the lengthy, fine-print user agreements for these platforms, so we unknowingly agree to these terms, which often include stipulations for data collection. Despite a recent increase in public awareness and pushback concerning consumers’ rights and privacy, platform developers stand behind the notion that the use of their applications is a choice we make as consumers. Thus, as a user, we must accept their agreements to access their software.
What happens when these devices start making their way into exam rooms? Your place of work? In a private area? It is one thing for a consumer to invite an *always-listening* artificial intelligence device into their home knowingly, but should we have a right to know when we are being recorded? Under the wire-tap laws, most states prohibit one-party recording, but many companies get around this by having people waive their rights, or they might place a notice of advisement. For example, have you ever heard the statement, “This call may be recorded or monitored for educational purposes?” There is your notice of advisement. Some businesses will post signs letting you know the area is under video surveillance, which may have integrated facial recognition, which opens a whole other world of AI possibilities.
Another form of AI is facial recognition.

Some hospitals are using AI to detect pain or discomfort in patients’ facial expressions, or to identify emotions such as stress, depression, or anger in a person’s voice. This technology is beneficial for nurse lines or suicide crises centers, but it can also allow an entity to know personal information about each consumer that walks through the door so they can tailor how they interact with you. Some retailers use it to prevent theft by uploading pictures of known shoplifters, and restaurants can tell who is a big tipper/spender as you enter the premises. A medical practice may use facial recognition to alert the staff about a known hostile patient or for auto check-in, or perhaps to protect sensitive areas such as the maternity ward, allowing access only to known family members.
Most people respond unfavorably when asked how they feel about using facial recognition software allowing other entities to access personal information without consent. However, we have already forfeited a lot of this personal information by agreeing to communicate on the various social media platforms and search engines that collect enormous amounts of data, including images of your face. I am sure by now many of you have uploaded photos to Facebook and noticed how it could automatically tag you in the picture without you making the decision. The same is true with Instagram, Twitter, LinkedIn, and others. Other data elements can be associated with these facial images, such as your spending habits, religious affiliations, political views, hobbies, etc. This allows anyone with this software to create customized approaches to how they target you or, worse, treat you differently (see Exhibit III).
Artificial intelligence in the exam room
Today, most healthcare provider organizations have electronic health records (EHR). However, these tools are static databases with algorithms that complement and support humans to complete simple tasks. They do not think for the users; they store data and serve as repositories of information. Now, with the advancement of AI, that factor is changing rapidly. AI today can augment human activity with the ability to:

**SENSE**

**COMPREHEND**

**LEARN**

AI in healthcare represents a collection of technologies that enable machines to understand and learn so they can perform administrative and clinical healthcare functions.
The primary aim of health-related AI applications should be to analyze relationships between prevention and/or treatment techniques and patient outcomes. Privacy policies must catch up to AI to ensure there is no overstepping of boundaries.

"Thus, the most obvious application of AI in healthcare is data management and its compatibility with our existing EHRs."

As with all innovation driven by data, collecting, storing, normalizing, and tracing its lineage is the first step in developing an AI strategy. Today, AI programs are already developed and applied to aid in the diagnosis process, treatment protocol development, drug development, personalized medicine, and patient monitoring and care. We are now expecting AI to make its way into eliminating repetitive jobs and allow for predictive automation.
The ethics of artificial intelligence
As AI advances, we will need to consider the creation of ethical standards that are applicable anytime patient data is used, with a specific emphasis on patient privacy and accountability for data usage. Now would be a good time to review your patient privacy policies to see how they may need to be updated for changes in your technology, which should also include patient messaging, patient portal, text messaging, and others.
Introducing AI into any industry generates a number of ethical questions:

- What happens when AI shows bias or acts discriminatory (see Microsoft’s Tay experiment), such as not allowing a patient with poor credit to schedule an appointment?

- How do we counteract inequality and distribute the wealth created by machines, such as when AI makes a diagnosis that would historically have been made by the provider?

- Can AI, meaning non-humans, have rights? If corporations can be viewed as entities, can the same be said of machines possessing artificial intelligence?

- How do machines affect our behavior and interactions?

- When AI causes harm, who is at fault?
Who owns the intellectual property developed by AI? AI innovation will take input from many sources, including providers and end users of technology. Should these users benefit financially from their input?

What happens to privacy and consent when AI is used for tasks like facial recognition? The current HIPAA laws do not address AI.

AI can now predict the propensity to pay; would patients deemed unlikely to submit payment be treated differently in a healthcare setting?

What becomes of our “right to be forgotten? Can corporations honestly ensure they can purge all of the data collected on consumers? The “right to be forgotten” is a national movement to force technology companies to remove our personal data being stored electronically.4

As industries move forward with implementing AI, these concerns will continue to be relevant, with more being introduced as the technology advances.
Moving forward with an AI strategy
As you begin the journey towards AI, it is important to keep expectations in perspective. Despite current advances, there are significant challenges in this field that include:

- Acceptance of AI at the point of care
- Availability of quality data from which to build and maintain AI applications
- Missing data streams
- Limitations of AI methods in health and health care software applications
From an adoption standpoint, we recommend the following:

- Learn and research AI (see Exhibit IV)
- Create awareness
- Change potentially negative mindsets toward AI with awareness campaigns
- Educate leadership
- Set low expectations at the beginning
- Identify easy wins (most critical)
- Embrace cloud computing
- Form a workgroup
- Identify gaps in data/capabilities
- Consider market-based platforms as opposed to self-developed
- Consider enlisting a third-party expert to transfer knowledge
In conclusion
The exponential explosion of the use of AI in healthcare environments compels industry leaders to consider the various applications available for adoption. Although AI delivers many solutions, it also is fraught with multiple problems for patients and providers. In this white paper, we have defined the current uses of AI, presented a series of ethical questions for consideration, and offered guidelines for establishing an AI strategy for your organization. Many resources are available to assist you in viable decision-making. For more information on how Coker can help your organization develop its AI strategy, please contact Jeffery Daigrepont at jdaigrepont@cokergroup.com.
Chatbot technology today most relies on what is called “if, do, what” logic. Consider a patient calling into a nurse line managed by a chatbot. The first interaction with the chatbot would likely include establishing if the person calling is the patient or calling on behalf of the patient. It might establish if the patient is male or female, and if the patient is new or established. If the patient is new, the chatbot interaction will be modified accordingly. Below is an illustration of the chatbot logic, which shows how patient input/answers gets converted to output. The hidden layer is where the programming takes place in accordance with the input.
Deep learning uses similar logic as described in Exhibit I, but instead exhibits multiple levels of representation, obtained by composing simple but non-linear modules that each transform the representation at one level (starting with the raw input) into a representation at a higher, slightly more abstract level. In simple terms, the outcome gets correlated with the desired result. If the result is not achieved, the AI factors this into the programing so that the machine will continue to improve. A well-known (and real-time) example of this can be seen when we use navigation maps on our phones. These navigations maps know the desired outcome is the fastest route, therefore the system is always adapting to current situations based on real-time input from road conditions being sent back by thousands of other drivers traveling the same roads.
Sample\textsuperscript{2} of facial recognition during customer profiling in a retail setting.

Sample\textsuperscript{3} of facial recognition being used to diagnose rare genetic disorders.
Online resources (both free and paid) for getting started in the AI field:

- [Udacity](https://www.udacity.com)’s “Intro to AI” course and Artificial Intelligence Nanodegree Program
- Stanford University's online [course](https://www.stanford.edu) “Artificial Intelligence: Principles and Techniques”
- edX's online AI [course](https://www.edx.org), offered through Columbia University
- Microsoft’s open-source [Cognitive Toolkit](https://github.com/microsoft/cognitive-toolkit) (previously known as CNTK) to help developers master deep-learning algorithms
- Google's open-source (OS) [TensorFlow](https://www.tensorflow.org) software library for machine intelligence
- [AI Resources](https://www.aiaccess.org), an open-source code directory from the AI Access Foundation
- The Association for the Advancement of Artificial Intelligence (AAAI)’s resources [page](https://www.aaai.org)
- Stephen Hawking and Elon Musk’s [Future of Life Institute](https://futureoflife.org)
- [OpenAI](https://openai.com), an open industry and academia-wide deep-learning initiative
Sources


