CHAPTER 1

# MACHINE LEARNING IN HEALTHCARE

RESEARCH
TO REALITY

ActiveState®

"Big data and machine learning in pharma and medicine could generate a value of up to $100B annually, based on better decision-making, optimized innovation, improved efficiency of research/clinical trials, and new tool creation for physicians, consumers, insurers, and regulators."

**McKinsey**

CHAPTER 1

# UNDERSTANDING ML ROLE IN HEALTHCARE

While Artificial Intelligence (AI), which is defined as the ability for a machine to make cognitive decisions without human input has garnered a lot of attention recently, it's Machine Learning (ML) that is actually delivering on the promise of what AI may someday achieve. ML allows computers to progressively improve their performance by learning how to do some automated task over time, typically a task that would previously have required human intervention.

But despite the great strides that researchers have made in the field of ML, it doesn't mean we'll all soon be replaced by machines. On the contrary, ML is a just a tool, and like any tool it can only be as effective as the user. This guide is designed to help you better understand ML in order to be able to wield it more effectively in your healthcare business.

ML has been a component of healthcare research since the 1970's when it was first applied to tailoring antibiotic dosages for patients with infections. But with the increased volume of Electronic Health Records (EHR) and the explosion in genetic sequencing data, healthcare's interest in ML is now at an all-time high. In fact, no other industry exhibits ML investments on the same scale as healthcare from 2015 through 2017. **(See Figure 1.)**

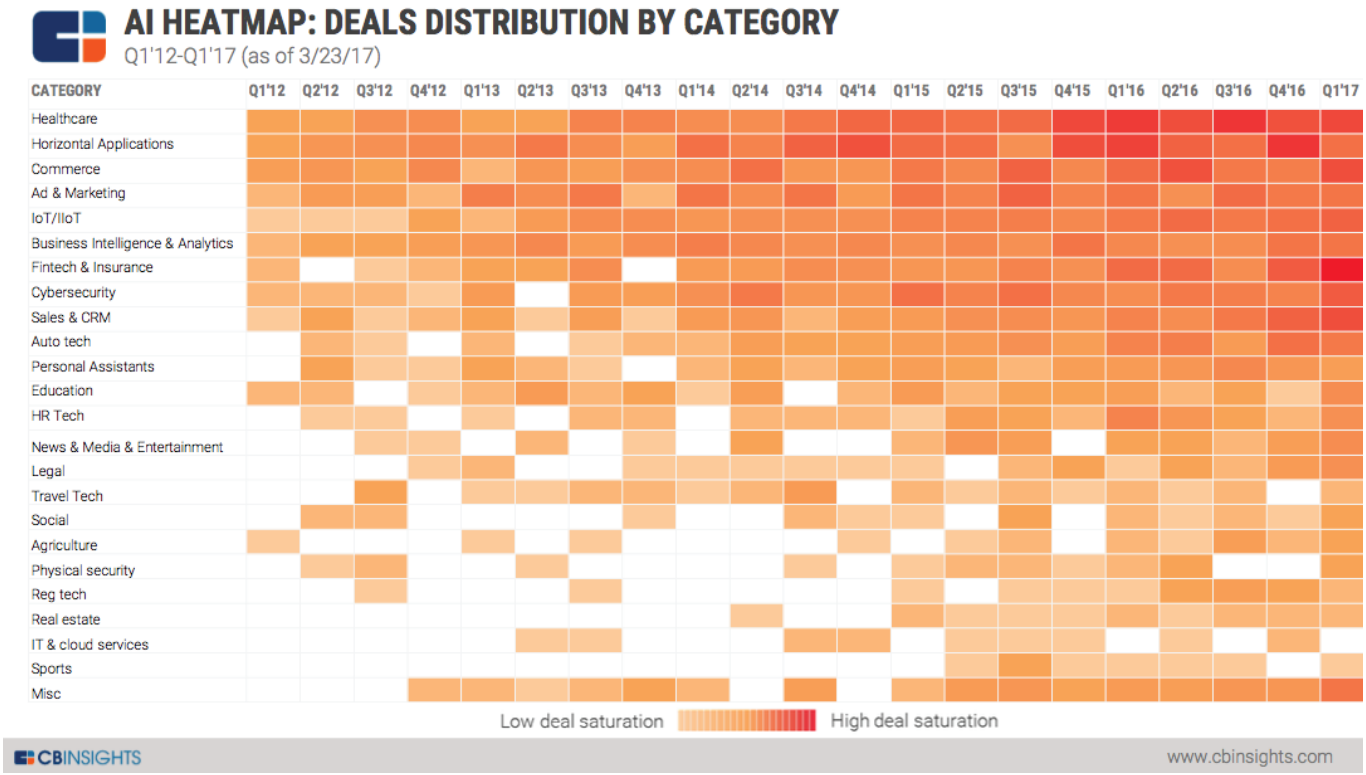


FIGURE 1: INVESTMENT IN ML BY INDUSTRY

McKinsey sums up this growing interest succinctly: "ML in pharma and medicine could generate a value of up to $100B annually, based on better decision-making, optimized innovation, improved efficiency of research/clinical trials, and new tool creation for physicians, consumers, insurers, and regulators." [1]

Both ML and healthcare are enormous fields unto themselves. This guide focuses on ML as it applies to the following aspects of healthcare:

- ML in Public Health Data Analysis
- ML for Healthcare Management
- ML in Genetics
- ML in Diagnostics

[1] https://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/how-big-data-can-revolutionize-pharmaceutical-r-and-d

## STATE OF THE INDUSTRY

Today the healthcare industry – from public health to hospital administration to research and diagnostics – is growing at a phenomenal rate as baby boomers age and medical technologies continue to provide significant advancements. ML has a potential role to play in all these areas, while helping to address one of the industry's most pressing concerns: rising costs.

According to the Organization for Economic Co-operation and Development (OECD), healthcare spending averages 9% of GDP for 34 of the 35 OECD countries. In the the US, the 35th country, that number is closer to 17% of GDP. On average, healthcare costs for the 34 OECD countries are growing at 4.9% per year, which exceeds the U.S. rate. By comparison, in China, a non-OECD country, healthcare spending is growing at a rate of 16%.

Skyrocketing costs are forcing the industry to do more with less, which is why digital transformation through technological innovation is key. ML is proving to be one of the best ways to optimize operations and maximize cost efficiency.

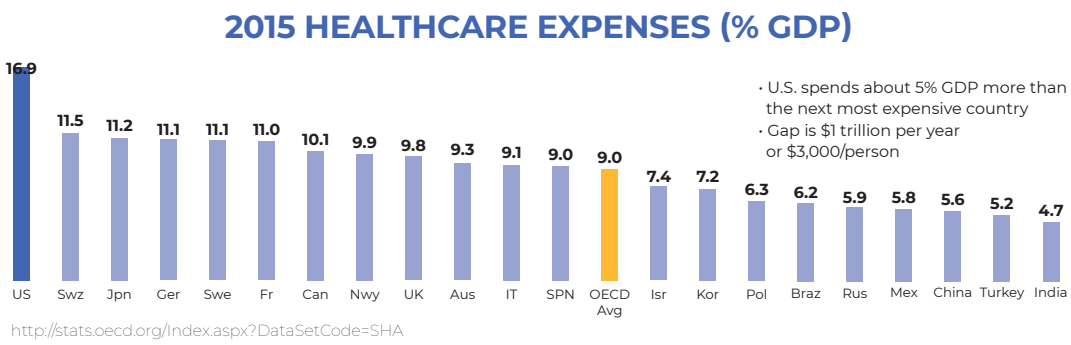


FIGURE 2: OECD HEALTH STATISTICS 2015

### ML in Cancer Care

University of Texas MD Anderson Cancer Center (MDACC) has been training IBM's Watson to improve the quality of care for cancer patients with no access to cancer specialists. The result is a virtual expert called MD Anderson Oncology Expert Advisor (or OEA) that provides both therapy decisions and recommendations to maximize treatment benefits. In other words, OEA is designed to share both the clinical evidence as well as the "art" of cancer care.[2]

[2] http://www.tomdavenport.com/wp-content/uploads/Lessons-from-the-Cognitive-Front-Lines-Early-Adopters-of-IBMs-Watson.pdf

## INTRODUCING ML

Analytics has traditionally been used to help discover insights in data. But analytics has proven ineffective when it comes to multi-dimensional and/or noisy data. This is where ML comes in, helping analysts identify actionable data patterns in complex datasets. The two most popular ways to apply ML are using supervised and unsupervised learning.

Supervised learning requires a large source of classified information, which typically means that human experts have already examined and labeled the data. For example, X-rays that have been classified into various categories of fractures versus breaks versus dislocations, etc. Using ML data scientists can then apply algorithms to the data in order to learn to classify it just as well as, or perhaps even better than, subject matter experts. In diagnostics this means finding patterns in clinical data that correlate with expert diagnoses. Or it may be used to identify patients who are at risk of particular post-treatment outcomes, and so on.

Unsupervised learning uses algorithms to find patterns in data that has NOT been previously classified. For example, unsupervised learning is the primary method used to identify the mechanisms for multi-factorial diseases. Unsupervised ML projects apply clustering algorithms in order to find ways to partition the data into some number of more-or-less isolated groups (i.e. clusters).

### ML in Radiology and Radiotherapy

Google's DeepMind Health is working with University College London Hospital (UCLH) to develop machine learning algorithms capable of detecting differences in healthy and cancerous tissues to help improve radiation treatments. ML speeds up the segmentation process (ensuring that no healthy structures are damaged) and increases accuracy in radiotherapy planning. [3]

[3] https://www.techemergence.com/machine-learning-in-pharma-medicine/