Machine Learning in Healthcare Applications
In 2019, US healthcare expenditures grew 4.6% to $3.8 trillion, or $11,582 per person. Thirty-four percent of those costs are spent on administration\(^1\). Healthcare costs continue to outgrow inflation\(^2\).
The summer of 1956 marked the beginning of exploring how machines can simulate human intelligence. Scholars gathered for a workshop at Dartmouth College for research and development in the artificial intelligence (AI) field.

AI has since made progress in fits and starts, giving rise to many promising technologies. We have seen massive improvements in the ability to process and interpret languages; increased fraud detection for financial institutions; and improvements in neural networks that train with gaming simulations (such as the AlphaGo program that was developed to play — and subsequently redefined the 3000-year-old board game Go). However, parlaying those advancements into business has been trickier — IBM Watson struggled to translate into a revenue source for IBM — even after Watson’s impressive wins on Jeopardy. One branch of AI, machine learning, has proven to be a powerful and versatile tool delivering a growing impact across various industries, including healthcare.

In 2019, US healthcare expenditures grew 4.6% to $3.8 trillion, or $11,582 per person. Thirty-four percent of those costs are spent on administration¹. Healthcare costs continue to outgrow inflation². Thankfully, machine learning is starting to make advances in healthcare as well so the future is bright. As the cost of care continues to rise, machine learning has an important role in lowering costs to make healthcare attainable and sustainable for average Americans. Since machine learning promises to reduce costs, provide better patient engagement and improve population health outcomes, healthcare leaders recognize that machine learning technology must be a part of the industry’s future.

There are five main uses for machine learning with applications in healthcare.
1 PREDICTION
Predictive algorithms learn from historical patterns and other signals in data to help humans understand what is likely to happen, which promotes efficiency and provides continuing value. Uber uses predictive algorithms to forecast rider demand and driver availability so users can reduce waiting time.

In healthcare, organizations can use this sort of logistical planning to improve the quality and lower the cost of patient care; reduce the number of unused, expiring drugs; and minimize underpayments on claim reimbursement.

**AI FORECASTS UNDERPAYMENTS.**

The Medical Group Management Association (MGMA) estimates that payers underpay claims by an average of 7-11%³, making it difficult for providers to gain their full reimbursements from insurance companies following procedures. With an estimated one in seven claims rejected in the U.S.⁴ and a likelihood of underpayment on reimbursed claims, hospitals have difficulty predicting the extent and timing of payments from payers. This uncertainty affects planning for payroll and purchases, like new equipment.

Using machine learning algorithms and historical data, Olive’s Underpayment Prioritization skill has built a model that evaluates a claim’s many factors — such as patient demographics, type of procedure, physician and payer — to predict the amount of effort needed to appeal the account for additional reimbursement and then prioritize which accounts should be appealed. By prioritizing claims properly, providers can collect the most receivables with the limited staff that they have. Knowing which claims are easiest to work and also which claims have the highest value can help providers collect the most money the fastest.

At one 2,000-bed academic medical center, Olive generated nearly $1 million over the 2020 baseline in lost revenue in only six months. In addition, by hiring Olive to collect underpayments in-house, the customer reduced vendor spend by $191k, a 58% reduction year-to-date. Olive’s AI-powered workforce also increased the total number of underpayment recoveries by 20% year to date, without hiring additional staff.

In 2019, healthcare expenditures grew 4.6%²

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CATEGORIZATION
Wading through a sea of data to identify errors or irregularities can take humans a very long time. Finding the opportunity for improvement from endless data points can often be difficult or too time-consuming for a human without aid. Using machine learning, automation algorithms can search and assess all of a provider’s records and only highlight those that need action.

**MACHINE LEARNING DETECTS CHANGES IN PATIENT STATUS.**

For example, physicians can have hundreds or thousands of patients on their panel whom they may care for in a given year. Overburdened panels can affect patient access to care; vaccination rates or preventive care visits are associated with reduced costs of care and improved outcomes. Proactive prevention can significantly improve patient outcomes and reduce the cost of care for patients highlighting the need for improved panel management processes. Panel management processes can therefore lead to improved access to preventive care practices for active empaneled patients.

Machine learning algorithms can proactively screen through all the patients on a provider’s panel and identify different groups of patients based on common features, conditions, or needs. Al-tailored engagement strategies can be deployed for each of these patient segments. The machine learning model can automatically determine segment categorization by clustering related individuals into groups with different levels of engagement so physicians can determine how best to handle each segment. Olive’s Panel Management skill is tailored to the needs of your organization and your patient community — optimizing access to care; this can include segmenting patients into:

- Regular and active patients
- Patients who have potentially left the healthcare system, such as when a mother or child moves back to a home health system following a birth
- Patients who need a soft reminder to return for a checkup

At one large Midwestern provider, Olive contacted patients on the provider’s panel through text messages. In line with the provider’s established practice preferences and with the help of automated text messaging, 10% of the provider’s panels were updated and removed from Primary Care Physician panels. Texting was a highly effective method and received a 50% response rate — an improvement over the 45% industry benchmark.

Olive helps patients schedule an appointment — improving access to care and increasing revenue opportunities for the provider.

**STATISTICALLY CHOOSE HIGH-QUALITY, COMPETITIVELY PRICED SUPPLIES.**

Another example of machine learning analysis is to reduce the cost of the supplies used in a procedure. Machine learning can identify variation in supply cost by evaluating procedure type, outcomes, patient type, and additional factors. After demonstrating this variation across comparable categories, humans can then select the most cost-conscious supplies. Hospitals, like many supply organizations, must cater to several different surgeons, procedure types, patient complexities and other needs. As a result, even “common” procedures can have significant variations in the supplies used every day. Surgical service lines must be prepared to provide necessary supplies to support the care of diverse procedures and provider preferences. With the variety of supplies, materials, and surgical implants available on the market, surgeons often have a favorite and cannot easily identify functionally equivalent, lower-cost options and the impact on outcomes for that item. This often results in unnecessary purchases of high-cost materials. And unlike other industries, changing supplies frequently requires significant review and approval from physicians.

The lack of price transparency around supplies often leads to higher healthcare costs — but it does not have to. Olive’s Surgical Spend Variation skill sorts procedures into similar cohorts before researching, identifying and recommending similar components for the surgery to reduce a procedure’s overall cost. For one $5B NPR health system, Olive helped them achieve $1500 average savings for each orthopedics case and $600 average savings for each urology case. Finding good opportunities for cost reductions requires looking at both the price of components and the clinical outcomes. Physicians will not reduce costs at the expense of care outcomes, so Olive makes recommendations on high-quality, competitively-priced alternatives that physicians can choose to implement.
Humans are capable of the complex problem solving and decision-making needed for resource allocation, but human capabilities are not infinitely scalable.

AI can quickly determine the best options for allocating supplies and staff time on an enterprise-wide scale — our proposed optimizations can guide humans to spend precious resources where they are the most valuable.

QUICKLY IDENTIFY HIGH-VALUE CLAIMS.

In the case of claims management, Olive optimizes human workflows and frees up staff time by checking the status of unpaid claims. Additionally, Olive’s Accounts Receivable Prioritization skill analyzes open account data through a machine learning algorithm — establishing the optimal prioritization for open claims. Olive’s analysis enables better managerial decision making to yield the highest ROI per touch from a workforce to maximize the ROI per touch and create additional capacity for value-add activities. By pursuing the optimal claims first, hospitals can get paid more quickly and reduce the overall cost to collect on the care they provide.
In healthcare, vast amounts of information is in unstructured formats and scattered across numerous documents that have yet to be digitized. This wealth of knowledge is critical to access and use alongside other data to make the most of other machine learning and automation algorithms deployed today. To understand this data and format it correctly into a usable form, Olive uses Computer Vision and Optical Character Recognition to convert text from papers, pdfs and other documents to machine-readable data.

**UNDERSTAND DOCUMENTATION.**

Computer Vision can read documents and recognize what type of document it is. Through pattern recognition, Olive can see if it is a health claim, a bill, or other note and then categorize it appropriately. Meanwhile, Optical Character Recognition utilizes machine learning to recognize the patterns of lines, spaces and shapes that create the alphanumeric alphabet. The documents that Olive reads span many different fonts, sizes and formats — requiring a powerful set of algorithms to identify from a scanned file what the document contains and correctly convert that to a structured file that is useful in other processes.

Once analyzed and converted, these documents are a vital source of information — greatly enhancing the effectiveness and value of the automation that Olive executes. These documents create a large warehouse of data to process claims, submit forms, and do other work that a human would previously have done. When these technologies come together in an ecosystem, the impact expands as the technologies build on each other and address ever more complex problems.
5 GENERATION
Humans can create using well-reasoned answers when inputs are clear or compatible. When it comes to healthcare technology, rule-based logic must keep up with ever-changing regulations. Yet with AI, intelligent automation can learn from and produce rules and predictions from the data alone without requiring updated programming. This automation adapts through changes in regulations to reduce the strain on hospitals’ limited staffing resources.

AI PROCESSES CLINICIAN NOTES MORE QUICKLY, WITH GREATER ACCURACY.

Hospitals need to provide payers a billing code to document the reimbursement cost of a given procedure. Some of these are straightforward, while others can appear to fall across similar categories. Typically, a medical coder reviews clinical notes on each patient visit and assigns the proper code, enabling the payer to assess and process a reimbursement. Reading every clinician note to find the details of care provided can be time-consuming and prone to error. This repetitive task can even delay claim submission, running the risk of filing outside a filing window and potentially delaying payment.

Enter Natural Language Processing. Olive’s Urgent Care Coding skill imports files provided for a given instance and selects the correct code for submission to the insurer. If Olive is unsure which code to assign, she can alert human coders to the more complicated cases while taking the simple ones off their plate. This Urgent Care Coding skill reduces medical coder burnout and increases the number of claims the team can process each day.

ARTIFICIAL INTELLIGENCE DELIVERS ONGOING IMPACT IN HEALTHCARE.

As a highly regulated industry where mistakes carry high costs and large consequences, healthcare has often lagged behind other industries when it comes to adopting new technology. But as the cost of care has skyrocketed with increasing regulation and reporting requirements, healthcare leaders have realized technology must be a larger part of the solution going forward. There will always be a need for skilled experts to implement and monitor machine learning to maximize business impact. But the tools and the technical expertise are growing at a fast clip and point to a promising future.

Companies like Olive are stepping in to meet this need and help improve the U.S. healthcare system. The industry applications for machine learning and artificial intelligence are numerous, and the technology has only delivered a fraction of the value AI promises to unleash in the next decade.
References


About Olive

Olive is the automation company creating the Internet of Healthcare. The company addresses healthcare’s most burdensome issues through automation — delivering hospitals, health systems and payers increased revenue, reduced costs and improved efficiency. People feel lost in the system today and healthcare employees are essentially working in the dark due to outdated technology that creates a lack of shared knowledge and siloed data. Olive is driving connections to shine new light on healthcare processes, improving operations today so everyone can benefit from a healthier industry tomorrow.

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