NLP (Natural Language Processing) is considered as a branch of AI that object towards reducing the communication gap between humans and machines. NLP is an application embedded into a robust system to provide capabilities to understand, store, process, and implement the driven insights in the form of speech or text that is understandable by a human. In the healthcare domain, the importance and usage of NLP systems are growing day by day. And these systems are creating a hype about their renowned application across the healthcare domain.

What drives NLP?

Embedding intelligent systems to optimize organization operations, increase quality time, and reducing operating costs is a common reason for a business in every domain. Even in healthcare, the reasons may remain constant at a point. But integrating NLP is helping healthcare beyond this. The two main reasons or use cases that drive NLP in healthcare are:

1. NLP could help in translating the human speech and make it understandable by a machine to extract meaning out of the information communicated.

2. To harness large chunks of data stored in the form of speech, text, pictographs, images, etc. and to derive meaningful insights, healthcare is leveraging NLP tools.

The set of tasks performed by NLP marking its prominence in healthcare.

* 1. Identifying the key elements in a lengthy document like clinical notes, health documents. And summarizing the required information into short notes.
* 2. Converting data from machine-readable to human understandable format.
* 3. Recognize unstructured data sets available in electronic health records and mapping them to structured formats that could be readable by a machine.
* 4. NLP based [chatbot](https://soulpageit.com/how-enterprise-chatbots-are-transforming-business-operations/) can answer text-queries that require analysis of multiple data sets.
* NLP can be used in optical character recognition to convert information in clinical test reports, x-rays, and scans into text-based formats to further readable by a machine.
* 5. NLP facilitates to understand and convert anything dictated into text through speech recognition.

The future of healthcare with NLP?

Embedding intelligent systems into healthcare units has leaped and the existing applications of NLP in healthcare include speech recognition, improvement in clinical documentation, computer-aided coding, and automated registry reporting. Emerging applications of NLP showing immediate impact on Healthcare units. Below mentioned are the few applications that helping NLP in pursuing a keen role in healthcare.

1. Clinical trial matching improves patient care and allows efficient access to clinical trials. It also helps in maximizing efficiency by providing support to the care team and reducing the burden in conducting and analyzing manual tasks. It clears the roadblocks in manual screening by expediting trial recruitment and by coordinating and monitoring the trial recruitment process.

2. NLP powered [clinical support](https://soulpageit.com/applications-of-nlp-in-pharma/) and prior authorization of decisions made by physicians and staff help hospitals inpatient clinical support, optimize the hospital operations, and endure the care provided. NLP based chat assistance and voice recognition systems help in making critical decisions based on patient EHR records.

3. The healthcare can manage population health and re-organize unstructured past patient’s data by integrating NLP systems and derive insights that help in offering better treatment at present.

4. NLP can be used in data mining to develop insights regarding formulating a [precision medicine for treating patients](https://www.cancer.gov/about-cancer/treatment/types/precision-medicine)with rare or new disease based on their genotype-phenotype history. Understanding a patient’s EHR, environmental, and physical factors they live in helps a clinical team in identifying the right pathway of treatment.

5. Imaging workflows: for radiologists tasked with analyzing thousands of patient reports, identifying, comparing, and reporting would be a time-consuming and hectic task. NLP integrated with image recognizing algorithms can detect the disease identification marks in different images upon a speech annotation.

6. Leveraging NLP helps in identifying and adjusting risk conditions to be provided by a value-based system. Using NLP in assessing blueprint of implementing technology could help in detecting operation accuracy and risk management in prior.

7. NLP tools are creating an ambient virtual experience between patients and physicians through a virtual platform without any physical meeting. The ambient virtual systems in prior investigate the patient’s EHR to make sure whether the doctor’s presence is indeed.

**Driving Factors Behind NLP in Healthcare**

**1. Patient Experience and Value-Based Care**

The unstructured clinical record and the patient feedback that comes after a visit contain insights into the patient experience that aren’t available in the structured record. NLP technology can identify these gaps by pulling key words and phrases from free text that will inform care decisions and benchmark the patient experience across physicians and locations.

This type of data mining in healthcare, made possible by NLP, can help reduce subjectivity in decision-making and help organizations deliver better, more efficient care to patients.

Meanwhile, the shift to value-based reimbursement means healthcare organizations need to measure provider performance and identify gaps in care for reporting to payers and regulators.

The value-based care model incentivizes both providers and payers to demonstrate positive patient outcomes after leaving the clinical setting. Data-rich health systems are now using natural language processing to analyze post-care survey feedback, online reviews, social media posts, and many other sources of unstructured text. These insights are key to identifying positive and negative patient experience factors that, if optimized or improved, will lead to higher CAHPS scores and provider ratings.

**Use Case:**

A [French research group](https://www.aclweb.org/anthology/W09-4506/) developed an NLP-based algorithm that would help monitor, detect and prevent hospital acquired infections. It made sense of unstructured data from clinical notes and patient feedback, and used those insights to identify early signs of infections and notify clinicians.

**2. Review Management and Sentiment Analysis**

In addition to patient experience improvements, NLP can help healthcare organizations manage online reviews in a highly regulated industry.

Natural Language Processing technology can collect and analyze the thousands of healthcare reviews posted every day on third-party listings, finding protected health information (PHI), profanity or other content relevant to [HIPAA compliance](https://binaryfountain.com/blog/ask-experts-hipaa-compliant-reviews/). It can also quickly analyze and evaluate human sentiment of unstructured comments, along with the context of how they are being used.

In [this case study](https://go.binaryfountain.com/rs/425-FDD-771/images/Temple-Case-Study-2019.pdf), learn how Temple University Health System leverages Binary Fountain’s NLP technology to analyze unstructured survey responses with an accuracy rate greater than 90%, turning qualitative data into quantitative business intelligence about patient experience.

Many healthcare systems also use text analytics to monitor the Voice of Consumer in reviews, so physicians understand how patients talk about their care and can better communicate using a shared vocabulary. Similarly, NLP systems can track consumer sentiment about your healthcare brand by pulling insights from positive and negative words or phrases within reviews or social media posts.

**Use Case:**

A Sant Baba Bhag Singh University [study](http://ijsrr.co.in/images/full_pdf/1553940671_166.pdf) found that using sentiment analysis from social media data helped providers improve treatments by understanding how patients talk about their Type-1 and Type-2 Diabetes treatments, drugs and diet regiments.

**3. Dictation and EMR Implications**

An average EMR record runs between 50 and 150 MB per million records, and the average clinical note record is [150 times as large](https://www.healthcatalyst.com/insights/healthcare-nlp-4-essentials). To manage that administrative workflow, many physicians are replacing handwriting or typing with voice notes, which NLP tools can easily interpret and add to EMR systems.

This application of NLP allows physicians to [automatically transcribe](https://tdan.com/natural-language-processing-in-healthcare/24538#:~:text=NLP%20has%20been%20successful%20in,accuracy%20of%20patient%20health%20profile) their conversation with patients, which means they can commit more time to improving the quality of care. But its implications go further.

Many of the clinical notes in EMRs are in unstructured form, but NLP offers a way to effectively, and automatically, interpret clinical notes. It can pull details from diagnostic reports and physicians’ letters, ensuring that all relevant information is uploaded to the patient health profile. For example, NLP systems could extract any notes in a patient’s electronic record that mention prescribed medications and if they were effective.

**Use Case:**

A [2018 study](https://www.healthcatalyst.com/insights/how-healthcare-nlp-taps-unstructured-datas-potential) used NLP to process radiology reports looking for pulmonary embolism and postoperative venous thromboembolism, and found that unstructured data analysis identified 50% more cases than structured data alone.

**4. Root Cause Analysis and Predictive Analytics**

Another exciting, but more complex, benefit of NLP is how predictive analytics can solve population health problems.

Applying NLP to vast caches of electronic medical records can help identify subsets of geographic regions, ethnic groups or other population segments that face different types of health disparities. Existing administrative databases can’t analyze socio-cultural impacts on health at such a scale, but NLP could pave the way for further research.

An often-cited example of this NLP application for healthcare companies is its use for Kawasaki diseases, where delays in diagnosis can lead to critical complications. In a [2016 study](https://onlinelibrary.wiley.com/doi/full/10.1111/acem.12925), an NLP-based algorithm identified at-risk patients with a sensitivity of 93.6% and specificity of 77.5% compared to notes manually reviewed by clinicians.

At the same time, NLP can be used to analyze unstructured feedback and [find the root cause](https://go.binaryfountain.com/091719-RootCauseAnalysis_On-Demand-LP1.html)of patients’ concerns or poor outcomes.

For example, healthcare-specific NLP can recognize phrases like “emailed us a video” as a positive sentiment concerning the topic of “Helping Patients Understand” within the “Provider” category. Monitoring long-term trends of sentiment surrounding topics in these categories, like “patient care,” “non-clinical staff” or “facilities,” can help organizations nail down the origins of negative patient experiences for providers or locations.

When patient experience personnel have a true understanding of a patient’s sentiment, they can conduct the appropriate outreach, perform service recovery and build a deeper relationship between the hospital and the patient.

Use Case:

A [2018 study](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6111391/) used NLP to predict suicide attempts by monitoring social media, showing clear indicators of imminent suicide risk by Twitter users who changed their speech patterns on the platform in specific ways. The system’s prediction rate hit 70%, with just a 10% false positive rate.

NLP Made Specifically for Healthcare

Data-driven health systems looking to optimize patient experience, reduce costs and improve care outcomes should consider the myriad insights hidden in unstructured data. With a wealth of patient feedback available, it is imperative for healthcare providers to begin investing and implementing NLP-powered patient feedback management solutions to secure and ensure patient loyalty.

**Semantic computing** is a field of computing that combines elements of [semantic analysis](https://en.wikipedia.org/wiki/Semantic_analysis_(knowledge_representation)), [natural language processing](https://en.wikipedia.org/wiki/Natural_language_processing), [data mining](https://en.wikipedia.org/wiki/Data_mining), [knowledge graphs](https://en.wikipedia.org/wiki/Knowledge_graph), and related fields. Semantic computing addresses three core problems:

1. Understanding the (possibly naturally-expressed) intentions ([semantics](https://en.wikipedia.org/wiki/Semantics)) of users and expressing them in a machine-processable format
2. Understanding the meanings (semantics) of computational content (of various sorts, including, but is not limited to, text, video, audio, process, network, [software](https://en.wikipedia.org/wiki/Software) and [hardware](https://en.wikipedia.org/wiki/Computer_hardware)) and expressing them in a machine-processable format
3. Mapping the semantics of user with that of content for the purpose of content retrieval, management, creation, etc.

[**Semantic computing**](https://ehrintelligence.com/news/can-the-semantic-web-revolutionize-healthcare-analytics) relies on the notion that computers can be “taught” to approach concepts and problems in a similar way to humans.  By linking together certain natural language concepts instead of just solving mathematical equations, computers can make inferences about data sets that might not be hard-coded into the system from the start.Semantic analytics requires curators and data scientists to write algorithms that group carefully developed categories of data elements, such as patient names, diagnoses, locations, or economic statuses, into possible relationships, instead of creating a new equation involving specific data elements each time there’s a new question to ask.

For example, a provider may have a list of patients in a traditional relational database that includes Joan Smith and Maria Smith.  That is very handy when Joan and Maria come in for their yearly physicals, but not so meaningful when Joan wants to talk about her family history of breast cancer or heart disease.

1. That’s because the sentence “Maria is Joan’s sister” requires a semantic understanding of key terms.  “Sister” implies a relationship between three data elements: “Joan,” “Maria,” and the hidden, shared link that is “Joan and Maria’s mother.”



### Clinical Documentation

Maintaining [Electronic Health Records](https://www.shaip.com/offerings/electronic-health-records-ehr-medical-data-catalog/) is time-consuming and laborious, and clinicians spend considerable time maintaining these records. With NLP, clinicians and doctors can get more quality time on their hands to invest in value-building tasks. Doctors can take down patient notes using speech-to-text, which makes data entry easier.

Also, EHRs are unstructured, so NLP can efficiently and automatically put together several **clinical notes**. The NLP system can easily pull together disparate clinical and diagnostic records, documents, and physician letters and upload them as a combined file in the patient’s EHR.

### Help Deliver Enhanced value-based Patient Care.

A typical patient record contains tons of **healthcare data,** but unstructured data and patient feedback don’t usually become a part of the clinical records. Yet, the feedback contains critical insights into the patient experience that helps in decision-making and streamlining the patient experience.

NLP makes data mining in healthcare possible, and when doctors have access to massive amounts of patient data, it helps deliver thorough non-subjective healthcare. NLP also shows great promise in identifying gaps in performance or care so that corrective action and reporting to regulators are not ambiguous.

Since patient health care continues after the patient leaves the clinical setting, **NLP helps analyze post-treatment feedback, reviews, and social media posts** to draw useful insights. These insights help care providers identify problem areas that affect patient experience and develop methods for**improving patient health.**

### Enhanced predictive analysis

Another interesting use case of NLP is predictive and root cause analysis using the data deposits. It is possible to detect patterns and subsets of groups likely to have a propensity to certain health conditions. When a delayed diagnosis of conditions can have devastating complications, NLP can help in early diagnosis.

### NLP tools to aid in clinical trial matching

With the help of**natural language processing**, doctors can quickly review large quantities of unstructured clinical data to recognize eligible candidates suitable for clinical trials. It is not only helpful in the research and development of medications but also in a better understanding of conditions. It also helps patients get access to experimental care that has the potential to improve patient health.

**Medical coding** is the translation of medical reports into a short code used within the healthcare industry. This helps summarize otherwise cumbersome medical reports into efficient, data-friendly codes. While complex and detail-driven, medical coding really comes down to knowing how to navigate the three main code sets: CPT, ICD, and HCPCS. These code sets help coders document the condition of a patient and describe the medical procedure performed on that patient in response to their condition

**NEED of Medical Coding**

1. Medical coding allows for the efficient transfer of huge amounts of information.
2. Coding also allows for uniform documentation between medical facilities. The code for streptococcal sore throat is the same in Arkansas as it is in Hawaii. Having uniform data allows for efficient research and analysis, which government and health agencies use to track health trends much more efficiently. If the CDC, for example, wants to analyze the prevalence of viral pneumonia, they can search for the number of recent pneumonia diagnoses by looking for the ICD-10-CM code.

### **COMPUTER ASSISTED CODING**

For over two decades, [AMI](https://www.artificialmed.com/) has been an industry leader in the Computer Assisted Coding and Natural Language Processing space. EMscribe® Computer-Assisted Coding (CAC) was the first commercial product to provide an Inpatient and Outpatient ComputerAssisted Coding Solution for all patient encounters.

EMscribe® Computer-Assisted Coding (CAC) software autonomously generates medical codes directly from clinical documentation using AMI’s innovative technology. It saves time, improves accuracy, optimizes reimbursement and streamlines the revenue cycle.

Highlights

* \*Immediate Return On Investment
* \*Extremely Accurate
* \*Not Dependent on a CAC Graphical User Interface
* \*Rapid Implementation
* \*Real Time Processing
* \*Mitigates Coding Labor Shortages

AMI was the first Computer Assisted Coding software vendor to install in an inpatient setting (2004) providing the benefits of Artificial Intelligent (AI) decision making to streamline workflows and reduce coding time, DNFBs, and increasing “Cash On Hand”