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Natural Language Processing

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Transforming How You Learn From
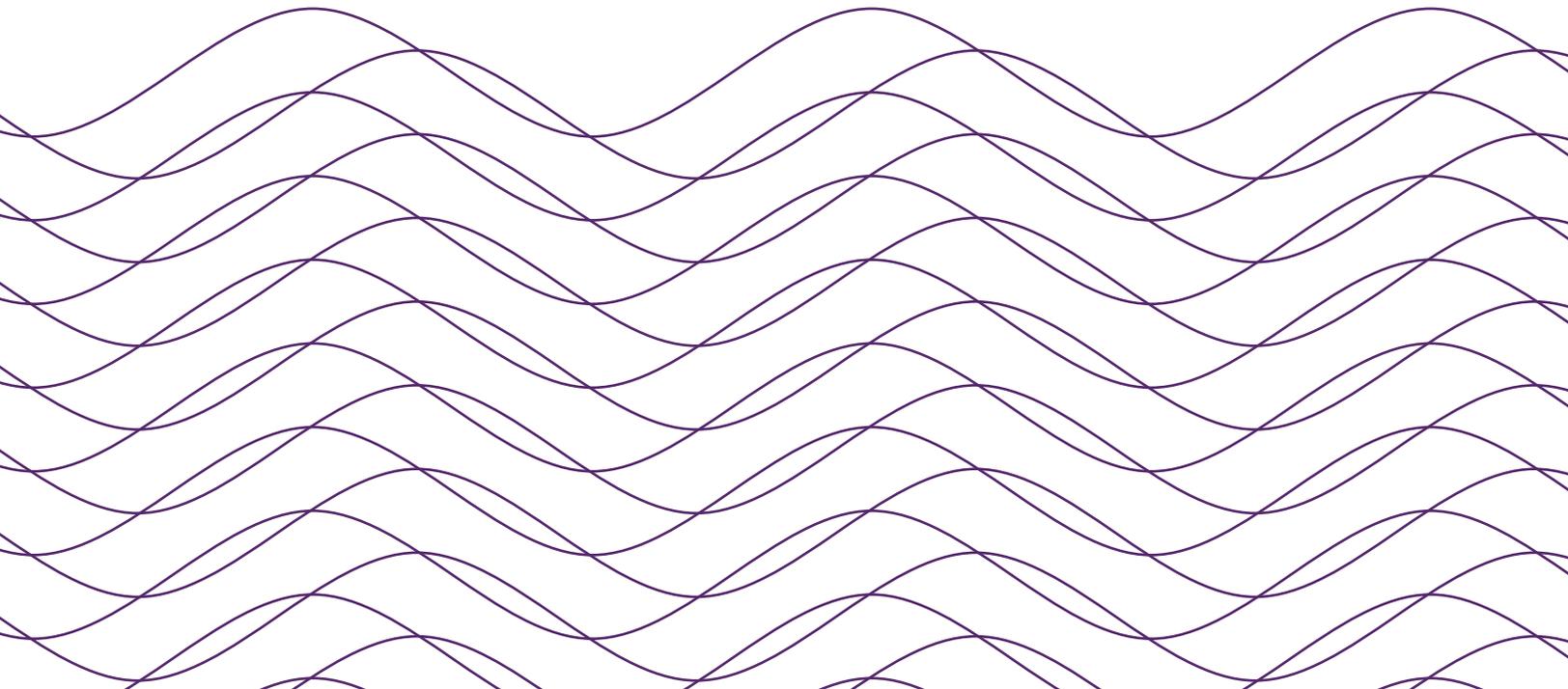Patient Reviews

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Introduction

As a healthcare organization, you've shown that you're dedicated to performance improvement and increasing the quality of patient experience across the board. Integral to this improvement, of course, is patient feedback, and thanks to CAHPS survey programs, patient-rounding programs and other initiatives, you have collected significant amounts of data. The question now becomes how to make sense of all this information. It's easy to quantify, of course—x numbers of patients were seen, x percentage of patients answered each question in certain ways. However, the true gold and insight doesn't always sit in the structured data, but in the free-form patient comments, where it's hardest to identify patterns, draw insights and put them into actionable steps through the traditional analytics survey companies offer.

As is often the case, the answer is inside the problem itself. Natural language processing (NLP) is a core component of artificial intelligence (AI) and has been gaining traction i n healthcare in recent years. By leveraging NLP, the massive amounts of unstructured data that is mostly used anecdotally can be turned into highly focused guidance on how to improve the patient experience.

At Doctor.com, we've built a proprietary NLP engine to make sense of unstructured data to provide deep insight into what patients are telling you.

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The dinner party

An analogy we like to use to help people understand how NLP can change the way they approach reviews involves meeting people at a dinner party. You could go around to every person and ask a series of sterile "yes or no" or even multiple choice questions and learn facts about them, but it wouldn't truly help you know them because your questions constrains how much they're able to share.

Indeed, you may not have even asked the most important questions and so don't even know what you're missing.

On the other hand, if you spoke with each person and asked only open-ended questions, you would get a much more in-depth understanding of their world. These types of queries prompt the person to share their feelings and thoughts without the arbitrary constraints of a more structured question, and they're not easily answered leading questions.

Think about it. If you asked someone "Do you have kids?" their response wouldn't tell you all that much. But if you said to the same individual "Tell me about your family," you'd get a much more holistic response with real-world application.

What is natural language processing?

Natural language processing is a branch of computer science used to analyze, understand and derive meaning from human language in a useful way. In particular, it's concerned with programming computers to successfully process incredible amounts of natural language data in a way that is similar to how a human processes conversations. NLP allows the computer to do the hard work of processing literally thousands of conversations and understand them well enough to identify patterns and sentiment trends.

Through NLP, developers can organize and structure knowledge to perform tasks such as automatic summarization, translation, named entity recognition, sentiment analysis, topic segmentation and more.

At Doctor.com, we've developed and tailored NLP processes specifically for the healthcare industry with regards to patient comments, with all of the nuance, quirks and privacy concerns of that field.

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What NLP can do with patient reviews

59% of patients incorporate physician reviews into their healthcare decisions, and 84% of customers trust online reviews as much as a personal recommendation. When people go online to research doctors, they want to learn as much as possible about them.

But of course, potential patients aren't the only ones who can learn from the plethora of ever-growing reviews obtained from both CAHPS surveys and third-party review sites. Healthcare organizations can learn tremendous amounts of information from these reviews, specifically in the realm of how to improve. Monitoring your organization's reputation is just the first step in being able to respond, adjust and grow.

And that's key. At Doctor.com, we're passionate about providing solutions that healthcare organizations actually use and benefit from.

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For healthcare systems and hospitals hoping to monitor their reputations, NLP makes possible the streamlining of an incredible amount of data. Just think, for a hospital with 200 doctors—if each provider gets only 20 reviews monthly through internal and external feedback, that's 4,000 comments every month!

With sentiment analysis, NLP can help by automatically identifying the feeling, opinion or belief of a statement, all on a Likert scale from "very positive" to "very negative." Additionally, the comments can be bucketed into categories which help to hone in with greater precision on problems and bright spots.

> *Healthcare organizations can learn tremendous amounts of information from patient reviews which can help themto improve.*

How Doctor.com's healthcare-specific NLP approach is different.

The team at Doctor.com has more than 20 years of experience in the healthcare field, and we know the specific challenges of the industry. Complicated medical jargon, HIPAA concerns, administrative complexities and patient comments regarding serious life-or-death medical situations all add staggering complexity to the review process—much different from the reviews for a restaurant or car repair shop, for example.

The common sentiment libraries other vendors use for building their NLP engines are not built for healthcare, because they are serving multiple industries. However, this becomes a problem in healthcare because not having an industry-specific tool can cause the results of the analysis to be compromised.

You've spent good money investing in your patient reviews (through CAHPS surveys and any transparency initiatives) as well as extensive time culling through third-party reviews—make sure you're extracting as much as value from them as you can.

The different types of NLP and how we use them

Sentiment analysis

Sentiment analysis is the use of natural language processing to systematically identify, extract, quantify and study subjective information. It's widely used in studying customer materials such as reviews and survey responses, online and social media, and healthcare materials for applications that range from marketing to customer service.

At Doctor.com, we use sentiment analysis to help our clients learn as much as possible from the reviews they collect from patients, from CAHPS surveys, third-party review sites and other data sources they may have. One of the most important tasks in sentiment analysis is classifying the polarity of a comment. That is, whether the expressed opinion is positive, neutral, or negative. This task can be easy, as in the following examples:

- Dr. Smith is kind and patient.
- I hate General Hospital.
- We had a horrible experience with the emergency room.

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Or it can be complex and challenging:

- I didn't hate the time I spent at Urgent Care. (negation handling)

- Occasionally, Dr. Smith can be less than nice. (adverb modifies the sentiment)

- Disliking busy doctors is not really my thing. (negation, inverted word order)

- The nurse handled my extremely upset stomach with grace. (negative term used in a positive sense)

- I just LOVE how patient Dr. Jones was. It was SO NICE of him to rush me through when I was in pain. (possible sarcasm)

The challenges of sentiment analysis in the healthcare field

Sentiment analysis is always complex, but it's particularly challenging in the healthcare industry when it comes to reviews. Some comments come from government-mandated surveys like CAHPS that are often gathered on paper and transcribed, sometimes missing words that could not be read or other transcription errors. Often comments are full of spelling errors and sentence fragments, as the healthcare industry sees interactions with people from every socioeconomic class and background.

These comments often contain details of the patient's treatment or their condition that are irrelevant to the sentiment relating to their doctor or the care he/she is providing. A patient may have cancer, which sounds both frightening and negative, but the care received may be absolutely stellar.

To counter all of this, we use a combination of three different algorithms to analyze each comment to not only give a more accurate sentiment but to permit us to estimate uncertainty on our analysis. This permits us to flag special outliers for review and to base possible modifications into our models.

One of these models we have specially tuned for physician comments to deal with the nuance of a world where terms like cancerous, tumor, malignant or terminal are all just statements of fact and only suggest a neutral comment.

This gives us an accuracy rating of over 95% on a five-point Likert scale and 99%+ on a three-point scale—well above most everyone in the industry.

Sentiment keyword analysis

This involves analyzing comments to extract important keywords and then looking at the sentiment in a comment to determine what the emotion is just in reference to that keyword. This lets you for example determine that the person was unhappy about wait time even though this was buried in an overwhelmingly positive comment.

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Topic segmentation

Topic segmentation is the process of dividing written text into meaningful units, such as words, sentences or topics. We use topic segmentation to place appropriate comments into a set of pre-selected buckets such as:

- Staff/billing
- Communication
- Demeanor/attitude
- Communication
- Parking/cost

By sorting out these topics into buckets, we can perform analyses across entire collections of providers (like all cardiologists in a hospital) or for just a single provider.

Often this kind of bucketing can find trends that would otherwise be missed. An example of this would be noting even though the overall sentiment for your hospital is positive, there are comments referencing the staff that are negative, sounding a call to action for performance improvement.

Another use would be by looking at a provider who always performs above the rest, it might become apparent comments about communication are what make her different and thus a target for replication.

Sentiment keyword analysis involves analyzing comments to extract important keywords to determine what emotion is in reference to a specific word.

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Named-entry recognition

In the healthcare field, patient privacy is paramount. Personal health information (PHI) under HIPAA is any information about health status that can be linked to a specific individual. Before any information is to become public, it must be de-identified, which mitigates privacy risks to patients and supports the use of data for studies, research and other endeavors.

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As part of our comment review in our transparency system, we perform **named-entity recognition.** NER is an important type of natural language processing because it can be used to answer many real-world questions about large numbers of comments, including:

- Is a certain doctor mentioned?
- Does the comment include a hospital location?
- Was a patient's name appearing in the review?

Many times, NER helps us find, group together and flag comments referencing people other than the physician the comment is about. Often this is a sign that PHI may have been exposed. One of the most common forms of this would be speaking about a family member or an underage child. The comment would then need to be partially redacted to protect the patient's privacy and enables HIPAA compliance. This also helps find comments that are mostly about other physicians, indicating the comment may need to be moved to another provider or split between the providers.

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Thematic analysis

While topic segmentation separates comments into a set of carefully chosen buckets, thematic analysis involves using NLP to read comments and letting the system create any bucket it determines is a theme - even if this theme is transient. This will sometimes pick up on subtle trends that would be otherwise missed or situations that are very unique to a single client.

For example, if a particular clinic building is in need of repair, a hospital wing is too cold or construction near a building is causing issues with wayfinding, these are all trends which may be transient but are opportunities for teams to identify and directly deal with them, thus improving patient experience and the reputation of the organization.

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Where we're going

Our work with NLP is just getting started. We are currently working on a second-generation model that we are constructing from the ground up solely from physician comments, based on our current data set of millions of reviews. By baking in the nature of this data from the ground up and combining it with a very large and carefully cleaned data set we expect to push our five-point Likert scale percentage to 99%.

Using our proprietary NLP, we have built the foundations of a very powerful AI system that will change how healthcare performance improvement, reputation management and even physician recruiting and risk management will be achieved. Armed with our systems, many of the leading health systems around the country are beginning to tap into the reality of the much-promised benefits of NLP and AI for their providers and patients.

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Learn more

Discover how your team can leverage these exciting new technologies by visiting **doctor.com/enterprise** or contacting **noel.coleman@connectcorp.com** for more information.