Under the Hood of Real-Time Solutions

Health systems have invested extremely large amounts of capital and time to understand and clarify the clinical information in patients' charts that is needed for appropriate reimbursement and quality care. Many of the steps and systems in the Documentation, Quality and Reimbursement processes are not integrated, resulting in inefficiencies between real-time point-of-care documentation improvement and back-end coding requirements. The result is a time consuming, labor-intensive effort to improve documentation after-the-fact.

Automation to shorten the documentation improvement cycle for both reimbursement and quality of care is possible. However, to do this the clinical information in the EHR must be accessible and actionable by technology which can process the information in real-time and apply a knowledge base to identify the clarifications needed from providers and their Coding and Quality function counterparts. Hiteks integrates and streamlines real-time interactions between clinical and administrative processes by offering an EHR-integrated solution prospectively at the front-end. Improved documentation and quality of care are automated which eases accessibility and action by the physicians to create more healthcare value and better patient outcomes. Workflow streamlining of quality reporting and ICD-10 coding lead to higher quality documentation, better quality reports, more accurate coding supporting higher levels of codes, and a more efficient work team.

The Core Engine for Real-time Healthcare Intervention

Early phases of information technology applied in healthcare were focused on retrospective analysis of information and improving billing through computerized support of manual coding workflows. The mass adoption of EHRs by themselves had failed to significantly impact the quality and cost of healthcare. In a new wave of innovation focused on improving clinical operational efficiency, quality of care and documentation for improved reimbursement, real-time intervention to providers as they enter data into the EHR allows for putting new knowledge from analytics to work.

Analytics activities in health care systems are growing through the use of data warehousing integrated into the EHR or as separate systems. Now that the right tools are in place to discover systematic quality improvements and cost reductions demanded by healthcare reform, the ability to take that new knowledge and apply it to the point of care is needed. As clinicians are documenting and synthesizing their Assessment and Plan for their patients in typed or dictated Notes, real-time and meaningful clarifications and reminders coming from matching the individual patient conditions with a knowledge base built from population-based research can be provided during their documentation. The new age of health care analytics now has the legs it was in search of when people asked "What are we going to do with all this data and new insights?!"

Real-time Provider Intervention Model

Many systems and vendors have tried real-time interventions previously and failed. Think of all the false-positive "alerts" that were created when Drug-Drug Interaction alerts in Pharmacy systems came online over the past 10 years. Think of all the clinically irrelevant laboratory result "out of range" alerts that are still part of Laboratory information systems. To intervene in health care, a system needs to have a solid financial and

quality basis of its intervention recommendation or clarification when alerting a busy clinician. Unfortunately, many systems are attempting to implement their new analytic knowledge in scattered, haphazard ways. Similarly, many vendors are selling narrow, hard-coded solutions based on a limited knowledge base and functionality which fail to provide the adaptability needed to accommodate continuous streams of new recommended improvements needed to documentation and quality care.

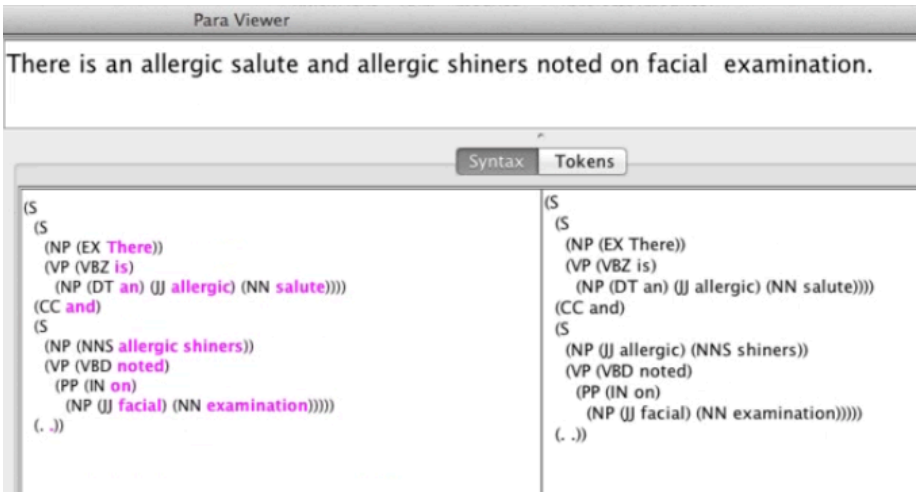
Hiteks has adopted the best practices and aspects of all the previously developed Clinical Natural Language Processing (cNLP) approaches over the past 20 years and created a commercial-grade platform and set of applications upon which to apply these approaches in real-time. Previous research in cNLP has focused on enhancing accuracy in areas such as negation and concept mapping to standard terminologies. These frameworks have been tested in large-scale national projects such as i2b2 and have leveraged clinical annotations from large university centers including Stanford, Penn, Columbia, and Vanderbilt, amongst others. When followed systematically and using commercial-grade tools to guide their implementation, real-time intervention is possible which is accurate and targeted to individual patient care to provide both financial and clinical quality benefits.

Although many large health systems have been told not to tie their analytics to their EHR vendor, the findings which take place through analytics need to flow back into the EHR for workflow integration and real-time intervention. Hiteks brings together the power of achieving advanced clinical text and structured data-based analytics with the ability to intervene at the point of care in real-time as the physician documents in the patient chart.

Under the Hood of cNLP

Advances in probabilistic context-free grammar research and technology allows us to train a parser on a tree bank (gold-standard corpus with annotated sentences as to their constituencies; includes the phrase structure of a sentence). Through this process we can better recognize the syntax of a clinical sentence and map it to the semantics that we desire for the cNLP application (e.g. automated CDI alerts to increase specificity of terms for ICD10 coding).

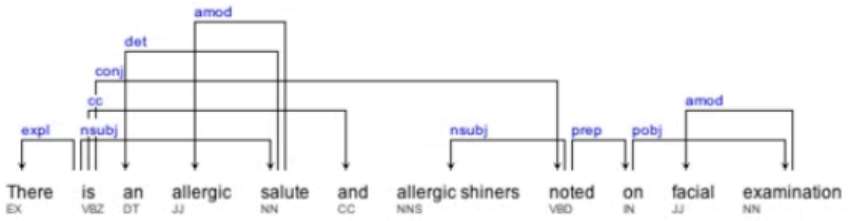
Figure 1: 2 Variations of constituency parsing on a clinical sentence



Constituency Parsing consists of taking a sentence and breaking it into its constituents based on rules for properly formed sentence structure. The accuracy of selecting the right parse tree is based on the grammar used to define sentences; however lots of ambiguity is created in this process. Statistical parsing allows for the algorithm to assign a best-matched parse tree from a tree bank. Most NLP vendors provide only Constituency Parsing types of cNLP which is good to map concepts from shallow, fragmentary sentences but poor for more typical narrative sentences that exist in clinical documentation.

Dependency Parsing recognizes the syntax of a clinical sentence and begin to map it to the semantics that are required. The verb becomes the root or head of the sentence and dependency relationships are discovered between the root and the other concepts in the sentence. For example, "reports" becomes the root of "Patient reports allergy to Penicillin and albuterol". The dependency approach to parsing allows for a better job on accuracy due to its improved recall and precision.

Figure 2: Dependency parsing of the same clinical sentence as in Figure 1



Hiteks uses both Constituency and Dependency Parsing in its approach to cNLP. In addition, Hiteks has lexicalized its parser so that it understands which clinical words and phrases should be treated as nouns and verbs. In Figures 1 and 2 above, "Allergic Shiners" is a lexical element in medicine that is a plural noun (compound concept), however standard parse trees will get tricked by not recognizing it since it wouldn't exist in a typical training corpus. For medication reconciliation Hiteks has created a formal language for medication signatures and implemented deeper parsing to solve the problem of identifying medications from not only lists but narrative mentions as well.

Software Design to Support A Range of Products Across Workflows and EHR Implementation Stages

Since Hiteks is solely focused on cNLP solutions and not distracted from speech-engine technology (which is a completely different type of engineering), it has purposefully developed a range of products, applications, and services that span the different stages and levels of real-time text processing. No matter where a health system is in its lifecycle of analytics or EHR workflow, Hiteks has a set of solutions that is optimized for and scalable to meet your future clinical intervention needs at your own pace. Real-Time Solutions require an architecture that includes scalable and modular design as shown in the Hiteks design, shown here:

Real-Time Solutions Engine Architecture and Modular Design