Computer-assisted coding: emerging technology today, primary coding technology tomorrow

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Computer-assisted coding (CAC) and its facilitator, natural language processing (NLP), are "trending topics" in health care today. These interrelated technologies are being increasingly discussed at health care association events and examined in health care trade publications.[1] A high percentage of hospital leaders are indicating that CAC is a tool to help them manage the complexity of ICD-10 coding.[2] And—perhaps the most telling indication of their growing importance—there has been a flurry of new CAC products and partnerships among health care vendors.[3]

The buzz surrounding this emerging coding technology is well deserved. As hospitals of every size and service area shift towards electronic medical records, traditional encoder technology is limited in how much it can leverage the benefits of digitization.

More than 95 percent of U.S. hospitals[4] use encoders to look up codes, assign and sequence codes, produce grouping results, ensure coding compliance, and send the

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[1] In addition to heavy CAC coverage in HIM-focused conferences and trade publications, health IT-focused publications and conferences are covering CAC. See, for example, *Health Data Management* magazine and HIMSS virtual conferences.

[2] Anthony Guerra. "healthSystemCIO.com survey shows CIOs researching ICD-10 coding tools." healthSystemCIO (blog). September 29, 2011. http://healthsystemcio.com/2011/09/29/healthsystemcio-com-survey-shows-cios-researching-icd-10-coding-tools/

[3] See, for example, 3M and Nuance (http://www.nuance.com/company/news-room/press-releases/NC_008464), MedQuist and M*Modal (http://www.healthdatamanagement.com/news/coding-computer-assisted-transcription-integration-40061-1.html), Precyse Solutions (http://www.emrandhipaa.com/news/2011/05/05/precyse-announces-commercial-release-of-revolutionary-intelligent-workflow-solution-for-health-information-management/), and QuadraMed (http://www.quadramed.com/getattachment/30685958-5c1e-4f39-b6e1-df3e351595fd/2010-9-27.aspx).

[4] HIMSS Analytics. *2011 Annual Report of the U.S. Hospital IT Market* (Chicago: Health Information Management Systems Society, 2011), 30. The report states that 96.11% of U.S. hospitals utilize an encoder

codes to their billing systems. In the 1980s and 1990s, encoders made coding more productive than coding with books and helped providers get reimbursed more quickly. But the coding technology advances happening now promise to eclipse the productivity gains and cost savings encoders provided. In this paper, I will show that CAC and NLP are to encoders what encoders were to coding books: technology that dramatically improves coding accuracy, productivity, and consistency and that reduces the previous method to a supporting role.

More complex coding requires more sophisticated coding technology

To understand where coding is going, it's useful to remember how it got to its current point. In 1979, when the U.S. health care industry adopted[5] the International Classification of Diseases, 9th Revision—Clinical Modification (ICD-9-CM), coding was largely a record-keeping exercise. ICD-9-CM, as the "C" in "ICD" implies, was designed to be a classification system, helping hospitals keep track of patient encounters.[6] But the 1970s were also a time of health care inflation,[7] and some public health leaders and policy makers saw coding as a method for tracking not only morbidity and mortality but also as the basis for paying for care,[8] with the hope of keeping health care costs in check.

The Health Care Finance Administration (HCFA), now called the Centers for Medicare and Medicaid Services (CMS), set up a pilot project in New Jersey to use a new grouping technology called diagnostic related groups, or DRGs.[9] After the New Jersey experiment, the Reagan Administration pushed for and received Congressional approval of a national prospective payment system, and in 1983 DRGs became the basis for all federal reimbursement for hospitals.[10]

To reduce Medicare payments, HCFA was given the power to attach a single, non-negotiable price to each DRG. HCFA's intent was to use their pricing power to incentivize hospitals to keep costs down.[11] Hospitals were required to group ICD-9 codes under the umbrella of DRGs. To prevent gaming of the new system, DRGs were to be chosen based on established rules and guidelines about which codes, and which combinations of codes, would be appropriate for each DRG.[12]

In a relatively short time, coding went from a simple, low-priority endeavor to a complex undertaking essential to a hospital's financial health. The established method of using books to look up codes and summarize the case using a paper form became too slow and inefficient. Out of this environment, the encoder was born.

In the 1980s, hospital leaders began using encoder applications to automate portions of the coding process. In doing so, hospitals saw improved productivity and reimbursement. But in the past decade, encoder innovation has reached a plateau.

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[5] *Historical Development of ICD-9-CM* (Delmar Cengage Learning: Florence, KY)
[6] Ibid.
[7] Rick Mayes. "The Origins, Development and Passage of Medicare's Revolutionary Prospective Payment System." *Journal of the History of Medicine and Allied Sciences* 62, no. 1 (2007), 22-23. doi: 10.1093/jhmas/jrj038
[8] Lawrence F. McMahon, Jr. and Helen L. Smits. "Can Medicare Prospective Payment Survive ICD-9-CM Disease Classification System?" *Annals of Internal Medicine* 104, no. 4 (1986): 562-566.
[9] Mayes, 31-37.
[10] Ibid, 51-54.
[11] David Henderson. "Medicare, Food Stamps and Rationing." *Library of Economics and Liberty* (website). June 2, 2011. http://econlog.econlib.org/archives/2011/06/medicare_food_s.html
[12] Marjorie A. Rosenberg and Mark J. Browne. "The Impact of the Inpatient Prospective Payment System and Diagnosis-Related Groups." North American Actuarial Journal 5, no .4 (2001): 90.

With the encoder as the primary coding tool, the possibilities for additional coding automation and productivity are limited.

Under the encoder model, the "heavy lifting" of coding—documentation review and code identification— continues to be a manual process fraught with the potential for error.

Interesting parallels exist between today and the 1980s. Health care inflation remains a concern. The impending move from ICD-9 to ICD-10 is about to make coding much more complex. And hospital leaders are concerned that increased complexity will lead to lower productivity, slower cash flow, and increased denials. The time is ripe for a technology that will keep health care providers ahead of the productivity curve. That technology is computer-assisted coding (CAC).

CAC, combined with advanced NLP, is the future of coding technology

CAC is "the use of computer software that automatically generates a set of medical codes for review, validation, and use based upon clinical documentation."[13] Most CAC applications generate this list of codes by automatically analyzing electronic documentation using a natural language processing engine. This documentation analysis is the key to CAC's effectiveness. After analyzing documentation, the NLP engine serves up a list of potential codes to the coder, who then validates the appropriate code.

The right NLP can dramatically speed up and improve documentation review. Improvements in revenue cycle efficiency can result from an NLP engine's ability to analyze all case documentation in seconds. This quick, comprehensive documentation review is not only a time saver, but can also enhance revenue. Advanced NLP is likely to pick up on diagnoses and procedures that human coders may miss, leading to a more accurate—and in many cases, higher—case mix index (CMI).

An NLP engine's proficiency at documentation analysis is also a key (along with CAC usability and workflow) to helping hospitals through the ICD-10 conversion. The speed with which an NLP engine can accurately review patient charts will help mitigate the productivity drop that hospital leaders are expecting when ICD-10 becomes the standard code set.[14] Additionally, since ICD-10 is expected to make the current coder shortage worse,[15] improved productivity from quicker documentation review and subsequent suggestion of codes can help coding departments do more with less.

If CAC solutions are to meet health care providers' expectations, NLP results must incorporate these attributes:

- **NLP results should be precise.** Some CAC/NLP offerings serve up long lists of potential codes, most of which are inaccurate. To find the right codes, coders must sift through dozens of "false positives." In NLP circles, limiting false positives, or "type-I errors," is referred to as "precision." The more precise a list of codes, the fewer false positives the list will contain.

[13] AHIMA e-HIM™ Work Group on Computer-Assisted Coding. "Delving into Computer-assisted Coding" (AHIMA Practice Brief). *Journal of AHIMA* 75, no. 10 (Nov-Dec 2004): 48A-H (with web extras).
[14] *Replacing ICD-9-CM with ICD-10-CM and ICD-10-PCS: Challenges, Estimated Costs and Potential Benefits.* (Simsbury, CT: Robert E. Nolan Company, 2003): 21-22.
[15] Sullivan, Tom. "Will ICD-10 Spark Coder Chaos?" *ICD-10 Watch* (blog), 24 May 2010. http://www.icd10watch.com/blog/will-icd-10-spark-coder-chaos.

- **NLP results should be comprehensive.** If the list of codes an NLP engine serves is missing a correct code, the list is said to be limited by a "false negative," or a "type-II error." NLP experts refer to this measure of accuracy as "recall."
- **NLP results should be linked to specific documentation.** While NLP takes the burden of a full review of documentation off of coders, coders still need to see specific documentation to confirm correct code identification. In sophisticated CAC applications, each potential code is linked to words, phrases, sentences, and paragraphs that the NLP engine used to identify the associated code. It is then up to the coder to determine whether the code is a false positive.

The major medical NLP technologies utilize different methods, and each achieves different results. In 2012, there are five different types of NLP engines used in medical coding:

- **Medical Dictionary Matching** approaches try to match individual words or groups of words with standard terminology from a medical dictionary.
- **Pattern Matching** techniques extend the capabilities of medical dictionary matching by coordinating terms with specific patterns of text that describe a diagnosis or a procedure.
- **Statistical Processes** gather information from a large, pre-coded sample of documents to "train" statistical algorithms based upon word and pattern distributions.
- **Symbolic Rules** systems analyze language using rules or lexicons,[16] identifying the elements of language with symbols that can be manipulated by the system.
- **Symbolic Rules with Statistical Components** utilizes both symbolic NLP and a statistical model of linguistics, including semantics (levels of language that contribute to meaning) and pragmatics (applying domain knowledge to recognize information in the correct context).

Table 1 highlights the degrees of precision and recall for each NLP method.

NLP METHOD	DEGREE OF PRECISION	DEGREE OF RECALL
Medical Dictionary Matching	VERY LOW (many Type I errors)	HIGH (few Type II errors)
Pattern Matching	LOW (many Type I errors)	LOW (many Type II errors)
Statistical Processes	INTERMEDIATE (moderate Type I errors)	INTERMEDIATE (moderate Type II errors)
Symbolic Rules	HIGH (few Type I errors)	INTERMEDIATE (moderate Type II errors)
Symbolic Rules with Statistical Components	HIGH (few Type I errors)	HIGH (few Type II errors)

Optum™ LifeCode®, the NLP engine used in all of Optum's computer-assisted coding products, utilizes symbolic rules and statistical components. Optum LifeCode uses two patented NLP methods. One method is called "vector processing," a mathematical model for isolating, comparing, and assigning different facts from clinical

[16] E.D. Liddy. "Natural Language Processing." in *Encyclopedia of Library and Information Science,* 2nd Ed. (New York City: Marcel Decker, 2003).

documentation to build a contextual framework. The second method is "mere-parsing," a process that determines meaning from free text, assigning meaning not just to single phrases, but also to a combination of related phrases from throughout the documentation.

These two methods combine to give health care providers superior precision and recall, which allow for higher productivity, better accuracy, and more consistency than encoder technology (and technology offered by many other CAC/NLP vendors) can provide.

As health care goes electronic, paper-era technology will slow the revenue cycle

Encoders are a holdover from the paper era. Paper was the de facto standard in the 1980s and 1990s when encoders helped advance revenue cycle productivity. Now that 90 percent of hospitals have some form of electronic medical record,[17] and all hospitals are being incentivized (and soon will be required) to embrace digital records,[18] keeping the encoder at the center of the coding process no longer makes sense.

Encoders limit productivity today because of steps essential to the paper-based model. Those tedious steps include complete documentation review accessing multiple systems, and the typical "logic-tree" process the majority of coders must follow to find the correct code. CAC streamlines the processes of documentation review and code identification from a coder's workflow, saving considerable time.

With CAC's advantages, what is the future of the encoder? Encoders will be used as a reference tool for some of their supporting features: edits, references, reimbursement, and case completion. Code assignment using an encoder will also be needed as long as hospitals utilize paper documentation. But with the continuing advancement of CAC, the use of an encoder as the primary tool to code cases will greatly diminish.

Still, a belief prevails among some purchasers that their choice of a CAC solution is limited by the type of encoder they currently use. Considering that CAC is poised to be the primary hospital coding technology, one's first priority should be selecting the best CAC/NLP product.

Computer-assisted coding: proven to save time and resources

Organizations that utilize CAC as their primary coding application can capture improvements not only in productivity, but also improvements in CMI accuracy.

Optum CAC clients have verified productivity and CMI improvements. For example, UPMC Health System, a 20-hospital integrated delivery network, was among the first adopters of inpatient CAC. Their Optum CAC system resulted in a 21 percent overall increase[19] in the number of inpatient charts coded per hour. UPMC hospitals also saw a 66 percent decrease in the amount of overtime their coders had to work, a difference they attributed to their CAC solution.

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[17]HIMSS Analytics. Data from HIMSS Analytics Database. 2012. http://www.himssanalytics.org/stagesGraph.asp. At least 91% of hospitals in 2011 were at Stage 1 of EMR adoption, meaning they had at least lab, radiology and pharmacy information systems installed. Seventy-three percent of hospitals were at Stage 3, meaning they had installed electronic documentation systems, error checking systems and hospital-wide PACS systems.

[18]David Blumenthal. "Stimulating the Adoption of Health Information Technology." *New England Journal of Medicine* 360, no. 15 (2009): 1478

[19]Nancy Soso and Adele Towers. "Inpatient Computer-Assisted Coding at an Academic and Community Medical Center." 2010 AHIMA Convention and Exhibit. Orlando, Florida. September 28, 2010. All UPMC statistics contained herein are attributed to this presentation.

In 2008, UPMC spent more than $800,000 on coding audits. Following their CAC implementation, they saw a decrease in external auditor recommendations of more than 50 percent, and as a result, their reliance on external auditors also decreased. UPMC saved more than $500,000 in yearly audit fees.

In addition, CAC helped UPMC increase their overall CMI. Before their CAC installation, Medicare CMI across the organization averaged 2.06. Two years after installation, UPMC's Medicare CMI averaged 2.25, an increase of eight percent.[20] They experienced that uplift without the aid of clinical documentation improvement programs. UPMC estimated total annual revenue impact due to the increased CMI to be $22 million annually.

OhioHealth, an eight-hospital integrated delivery system located in central Ohio, is another organization that recently made CAC its primary coding application for five of their facilities for both inpatient and outpatient coding. The inpatient solution was installed later than the outpatient solution, so inpatient productivity numbers have yet to be analyzed. But the outpatient implementations helped OhioHealth gain a 190 percent increase above their average diagnostic coder productivity standard and a 116 percent increase above their average ED coder productivity standard. These increases have compelled OhioHealth to set new, more aggressive coder productivity standards. CMI has also improved by nearly two percent over the average case mix prior to their CAC implementation.[21]

Finally, Gwinnett Hospital System in Atlanta, had already benefited from a robust documentation improvement program when they installed their CAC solution. Gwinnett leaders anticipated only a modest one percent CMI increase due to CAC. However, their CAC solution has helped them improve CMI by 3.4 percent, allowing the solution to pay for itself within three months.[22]

These impressive results came about because these hospitals chose Optum's CAC solution, which uses the most mature and advanced medical NLP on the market.

For medical NLP, coding is just the beginning

The combination of CAC and NLP has evolved over the past dozen years from a specialty-focused technology used only in an outpatient setting to an enterprise-wide solution used in nearly every aspect of hospital coding. And the technologies will continue to evolve.

The next evolution for CAC is to integrate encoder-like functionality into its interface. As coding requirements continue to expand and become more complex, hospital leaders will want to leverage the economies of scale that a combined coding solution provides. Adding code assignment, grouping, pricing, editing, and modeling as well as integrating

[20]Many factors affect case mix—a strong documentation improvement program or new services being provided by the organization, for instance. Other factors are outside of an organization's control. Although the more comprehensive documentation review provided by CAC can improve CMI, results may not be typical.

[21]Diane Setty. Email message to writer. December 12, 2011. CMI percentage excludes DRGs related to mothers and babies. All OhioHealth statistics contained herein are attributed to the email.

[22]OptumInsight. *Gwinnett Hospital System improves revenue, enhances coder productivity, mitigates audit risks, and prepares for ICD-10 with Optum CAC*. (Eden Prairie, Minn.: OptumInsight, 2012), 1. http://go.optum.com/interactive/microsite/2011/11-26855/docs/Gwinnett_Case_Study.pdf

coding references to CAC applications will further streamline coding, eliminating the need to toggle between a CAC application and an encoder.

Medical uses for NLP are not limited to CAC or speech recognition. Momentum is building in the health care industry to leverage NLP to make clinical documentation improvement (CDI) processes more automated, accurate, and measurable. NLP can boost the productivity of CDI specialists by abstracting the information needed to identify potential physician query scenarios. Just as CAC turns coders into reviewers/editors, CDI specialists would review NLP coding and abstraction results to quickly find documentation deficiencies. Using medical NLP, documentation improvement concurrent to the patient stay will be made easier.

Evidence-based clinical practice could also be dramatically improved with medical NLP. Using NLP to compare clinical documentation against a database of evidence-based medical practices would give providers real-time information related to their quality of care. Chief medical officers could use this data to present scorecards to doctors based on hospital, system-wide, regional, and nationwide averages, using the latest data for immediate care improvement.

Quality reporting could also be streamlined by NLP. Pairing NLP with health quality data could be used to automatically generate core measures for reporting to CMS and to The Joint Commission.

Conclusion: CAC is poised to become the primary hospital coding technology

The potential for CAC to improve coding productivity and revenue is significant, and the results speak for themselves. Being under constant financial pressure, health care provider leaders will not accept the status quo for coding and reimbursement.

Organizations will leverage the power of electronic medical records by making computer-assisted coding the backbone of their coding operations. Those who choose solutions with sophisticated and mature natural language processing technology will rely less on their encoders to perform documentation analysis and code identification. And hospital leaders will have confidence that their HIM operations and overall revenue cycle are more robust, efficient, and accurate.

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