

**HITPC Clinical Documentation Hearing
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Panel 1: Role of Clinical Documentation for Clinicians

Innovations in Clinical Documentation

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Thank you for the opportunity to discuss innovations in clinical documentation. The promise of electronic clinical documentation is high [Schiff 2010], but many challenges remain [Cusack 2012, Weir 2003]. The challenges will be covered by other speakers so we will focus on innovations.

The goal is to produce documentation that supports the care process, that is efficient to author, and that meets the myriad requirements outside of clinical care, such as billing, accreditation, legal, and research. For the documentation to be actionable, either for decision support within the care process or for external uses such as research, it must be encoded in a format that can be computed. Therefore, scanned handwritten documents—which are often unintelligible to human beings as well as handwriting recognition systems—cannot support a data-driven health system.

Today, most documentation systems are characterized by whether they support narrative note entry, structured data input, or a combination of the two [Rosenbloom 2011]. With fully narrative note entry, clinicians write notes as if the computer was a typewriter with a blank piece of paper. No structure is imposed. This has the advantages of being flexible, requiring little training, fitting into the clinician's conceptual model, and supporting a deep description of the clinical case. Unfortunately, such systems are frequently plagued by copy-and-paste duplication and redundancy [Wrenn 2010], there is no opportunity to steer or remind the user about the missing elements, and encoding the information requires natural language processing.

Natural language processing extracts information from narrative clinical reports so that clinicians can document in a form that is flexible and natural while the information can still be used for quality improvement, population management, and research purposes [Spyns 1996, Nadkarni 2011]. The technique has been used effectively in health care for about 20 years. In the 1990s, we showed that a natural language processing system can extract information about as accurately as a human expert such as an internist or radiologist [Hripcsak 1995]. Extensive experience since then has revealed that human coding is slightly more accurate, but both are fallible. We showed that natural language processing systems are transportable across institutions [Hripcsak 1998]. We demonstrated the first use of such a system to improve clinical care in a prospective study of tuberculosis management [Knirsch 1998], and we demonstrated use of the system to uncover adverse events from narrative reports, achieving a specificity of 0.9996 and sensitivity of 0.27, which was three times the manual process [Melton 2005]. Subsequent work by an independent group achieved higher sensitivity at a lower specificity [Murff 2011]. There is currently an explosion of interest in natural language processing with commercial and academic projects [Uzuner 2008, Nadkarni 2011]. With current systems, reasonable information extraction can be

achieved with minimal effort, and very high performance can be achieved if task can be sufficiently constrained and there is sufficient time to train the system to the problem (e.g., smoking status [Uzuner 2008]).

Direct structured data entry uses forms, checkboxes, menus, etc. to steer the author to enter the answers to specific questions. The technique can remind the clinician what needs to be entered, it produces information in a format that is repurposable, and it can be quick if the clinical process is constrained. Unfortunately, the author can only document what was envisioned by the creator of the form, and for complex cases, entry can be slow. The end result is a system that authors often find difficult to use (e.g., AHLTA [Staggers 2010]).

The state of the art in documentation today is semi-structured input, where clinicians can record their thought processes into shorter narrative sections, but high priority data elements can be collected as structured information. In an extensive review of the tension between structured documentation and more flexible narrative data entry, the authors recommended that no single approach is likely to work, and that several tools may be needed [Rosenbloom 2011]. The group recommended that “documentation method selection be made on the basis of clinical workflow, note content standards and usability considerations, rather than on a theoretical need for structured data” [Rosenbloom 2010].

The next generation of documentation systems can evolve in several directions. One direction is to exploit knowledge engineering to improve structured data entry by steering what fields are included in the form and to provide decision support (e.g., alerts, order sets) in real time. For example, fields in a form can change dynamically based on what has been previously entered, similar to computerized adaptive testing. A sophisticated documentation system called Smart Forms was intended to improve quality by incorporating decision support into the documentation process [Schnipper 2008]; it uses structured and unstructured elements. The challenge, however, has been use. Prospective trials of Smart Forms showed limited use but promise when it was used [Schnipper 2010, Linder 2009]. Some vendors have also incorporated a similar technique, but again, response has not been overwhelmingly positive. Challenges include the complexity to the user in filling in a form that changes dynamically, a lack of flexibility once one is headed down a clinical path, and the creation and maintenance of the knowledge base of forms and decision support.

A second direction is to focus on narrative data entry, providing an environment that is natural for the clinician yet still able to assist the authoring process by recognizing missing items and providing decision support. Such systems exploit natural language processing in real time. One example is the Structured Narrative project [Johnson 2008], but it was never put into production. At this point in time, the approach is technologically challenging and remains a research topic.

A third direction, not implemented yet, is to incorporate data mining into the authoring process. Instead of generating a knowledge base of forms, this approach relies on the collective experience of all previous notes to steer how data should be entered in a new note. The technology would incorporate elements similar to those in the IBM Watson project (IBM Corporation, Armonk, NY). Challenges include steering the authoring process to better practice (as opposed to past experience) and reducing the noise that is inevitable in the data mining process.

A fourth direction is very practical: study the authoring process and iteratively refine it with the goal of improving the user experience rather than attempting to directly improve care. The motivation is that a clinician who is writing notes effectively will produce better notes and better serve the care process, and thus indirectly improve care. One example is the SmartPaste project, also known as the QuickNotes project [Owen 2012]. It speeds the documentation process by allowing users to quickly review and insert relevant information while documenting, and it allows users to create their own documentation templates.

The goal is to reduce widespread duplication of text in notes day after day, allowing clinicians to instead focus on identifying trends and patterns. Even though use of the tool is optional, it has been almost universally adopted at our medical center, and it has been disseminated to other hospitals around the nation, including the NIH Clinical Center. The challenge is that it does not eliminate potentially superfluous information, or clutter, in a note because it makes it easy to insert items like laboratory results, radiology reports, medications, etc. that are available elsewhere in the record. Current work is focused on separating the documentation of the clinician's thought processes (what they saw, what they did, and what they plan to do) from documentation of the supporting evidence, perhaps using the electronic health record's audit trail to automatically record the supporting evidence that was reviewed by the clinician.

A fifth direction is to change the documentation paradigm altogether. For example, perhaps detailed documentation of the encounter can be relegated to a video recording of the clinical encounter (J. Marc Overhage, personal communication), which can be reviewed as needed for legal or billing purposes or even for clinical purposes such as recalling the timing of a symptom. The formal documentation would then only need to contain those elements that are essential to steer the care process, thus reducing the documentation burden.

A sixth direction is to focus on the collaborative care process, creating an authoring environment that promotes shared documentation. General models include Wikipedia (Wikimedia Foundation, San Francisco, CA) and Google Docs (Google, Inc., Mountain View, CA). One example used a central virtual whiteboard accessed via mobile devices [Mendonça 2004]. The main challenge in this approach is that it does not address the challenges of single-author documentation, but only adds further complexity.

A seventh direction is patient engagement. Just having patients review the notes written about them may have an effect. For example, the OpenNotes project's surveys reveal that providers are likely to modify their documentation practices knowing that patients will review it [Walker 2011]. Patient data entry may obviate the need for some data entry by clinicians, although clinicians' interpretation will still be needed.

Further advances in data entry technologies, such as speech recognition, handwriting recognition, and recording technologies, as well as natural language processing and data mining technologies may enhance the documentation process. Furthermore, there are opportunities to link information within the record to facilitate the process. For example, rules applied to structured data entered elsewhere in the electronic health record have been used to infer the presence of problems that should be entered into the problem list [Wright 2012].

Study of the documentation process [Mamykina 2012], structure [Wrenn 2010], and use [Hripsak 2011] should lead to a better understanding of how to improve it. For example, note creation was found to be a highly interrupted process [Mamykina 2012], so the authors proposed that documentation would be best supported "with tools that facilitate data exploration and search for relevant information, selective reading and annotation, and composition of a note as a temporal structure." Being able to quantify the quality of documentation is also essential to make progress. A Physician Documentation Quality Instrument has been developed and studied [Stetson 2008], and a shortened version has been made available [Stetson 2012]. Further work is needed in understanding the effect that the documentation method or documentation quality has on quality of care. Initial work [Linder 2012] does show a correlation between method and care.

In summary:

- (1) There is no single documentation approach that can or should be mandated at this point in time and, in fact, a combination of approaches may be best. Semi-structured data entry appears to be the current state of the art.
- (2) Attempts to directly improve the quality of care through top-down quality-driven documentation have so far had limited success. Attempts to improve the documentation experience have seen quicker adoption, but they have not directly improved care.
- (3) There are a number of promising documentation directions and more research and development is needed, both in industry and in the academic community.

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