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Synopsis

Computer-based Patient Records

In 1970, Dr. William Schwartz boldly predicted that "it seems probable that in the not too distant future the physician and the computer will engage in frequent dialogue, the computer continuously taking note of history, physical findings, laboratory data, and the likes" [1]. In 1991, the Institute of Medicine reported [2] "No operational clinical information system in 1990 can manage the entire patient record with all its inherent complexities". In this perspective, any prediction for future success appears risky, yet the dissatisfaction with the medical record appears to precede its electronic instantiation. Over one hundred years ago, Florence Nightingale wrote, "in attempting to arrive at the truth, I have applied everywhere for information, but in scarcely an instance have I been able to obtain hospital records fit for any purposes of comparison. If they could be obtained... they would show subscribers how their money was being spent, what amount of good was really being done with it, or whether the money was doing mischief rather than good..."

Part of the problem may be the multiplicity of goals that various parties wish to place on the fragile shoulders of medical record systems, paper or electronic [3]. To enumerate only a few of these goals: communication between care providers, medico-legal protection, outcomes analysis, longitudinal record for care, medical discovery, quality control and real-time decision support. Efficacy in meeting one of the goals does not at all predict efficacy in meeting another goal, particularly in the implementation of Computer-based Patient Records (CPR's). For example, it may be that for the goal of communication between providers, unstructured narrative text viewed linearly or via a fast, indexed, text search engine might be adequate. For outcomes analysis however, such a record without any controlled vocabulary or structure is highly inadequate. Furthermore, the design, engineering and sociology of deploying a structured record with a controlled vocabulary is quite different than that of a narrative, unstructured record. Therefore, it is quite predictable that even if a system were to be implemented that served one of the CPR goals very well, there would be substantial criticism regarding its failure to meet the other CPR goals. Yet, even a simple unstructured CPR geared for communication, would already represent a much higher degree of function than the current, paper-based patient record in its accessibility, shareability, searchability and compact archival form.

The aforementioned problem notwithstanding, informaticians, at least those with any longevity in this field, are apparently a group of irrepressible optimists. Despite the difficulty in meeting the multitudinous goals of the CPR, efforts to achieve the holy grail, the all-purpose CPR, have continued for well over thirty years. Part of this optimism may be justified by the accumulation of wisdom and the never-ending progress of ever more leveraged new information technologies. The worry however, is that some of the optimism stems from a lack of knowledge of the many ways CPR efforts in the past have succeeded or failed and we will be doomed to revisit our errors generation after generation. In this light, the review by Tange et al [4] is particularly valuable. They have provided a chronologically organized description of the development of CPR's, carefully highlighting the contributions made by each CPR but also tactfully delineating the ways in which these systems have not succeeded or fully met their designers' expectations. To provide the reader with an overarching framework, the review is partitioned across two dimensions. The first dimension distinguishes "classical" systems from the "experimental" systems. The second dimension is defined by three major themes: data entry, user interface, and machineability of data. The review explicitly omits evaluating all current commercially available systems. This is understandable but unfortunate as an impartial review of commercial

CPR's within the framework provided by Tange et al. [4] would be of great utility. Regarding the non-commercial systems, they make quite a few interesting, if controversial points. First they note that the classical systems, developed in the 70's and 80's, rarely have much in the way of clinician-entered data and rather focus on integrating non-clinician-derived data (e.g. laboratory results, administrative data). Furthermore, they note that these systems have been difficult to adapt to modern user interfaces, and data entry techniques. With the advent of "web-wrapping" of legacy systems, their conclusion may be correct at this time, but premature. The experimental systems, in contrast, provide several intriguing examples of methods to enable clinicians to enter data. These methods range from full control of clinician entry through intelligent user interfaces to post-processing of narrative with natural language techniques. The reviewers point out that in all evaluations to date, for the purpose of clinical care, clinicians prefer a natural language summary, whether it is generated de novo from data coded in a controlled vocabulary or represents the original prose of the clinician. Unfortunately, the reviewers also make it clear that none of these techniques has been so successful as to dominate the others, nor have very many of the experimental systems made the transition to large-scale clinical use.

Nguyen et al. [5] report on a case history of "experimental systems" (in the sense of Tange et al. [4]) that have made the transition to full clinical use successfully. They describe a study in which they evaluated the performance of a narrative report generator they call "Professor Belmonte" which has been used since June of 1996. The particular application domain is bone marrow aspirates and the reports generated, from structured data elements, are narrative summaries. These summaries not only abstract the findings, but also provide an interpretation of histology and differential diagnosis. Overall, domain experts in this retrospective study rated the automatically generated reports as of comparable quality to the human generated ones. Although this study does not speak to the problem of data entry, it does demonstrate that once captured, structured data in some domains can be effectively used to generate acceptable narrative reports.

Once we do have successful full-fledged CPR's, it is highly likely that we will wish to share data among them. The history of the database technology behind CPR's has made data sharing efforts quite challenging. One important reason is that, until recently, few CPR's were built upon relational databases and could not therefore exploit modern database design techniques. Pierik et al. [6] follow the path set by Johnson [7] in the application of rational relational database design methodology to the task of building shared or re-usable data repositories for CPR's. In addition to the judicious use of normalization, the creation of a core set of generic, time-stamped relations was identified as essential for the long-term evolution and maintainability of the multi-purpose database. Resolution of semantic ambiguity or incompleteness were also identified as important tasks. However, experience with truly disparate databases suggests that such resolution is very difficult if at all possible [8]. Nevertheless, as the next generation of "classical" CPR's are implemented, the techniques described by Pierik et al. [6] and Johnson [7] will prevent many of the most common errors in CPR database implementation.

Anne Birgitte Als [9] describes a cautionary study that provides so[me] hints as to how the presence of a CP[R] can have a negative effect on t[he] patient-clinician relationship. Usi[ng] well-established sociological tec[h]niques, she studied clinicians' intera[c]tions with patients in the presence o[f] desktop computers, which have be[]come quite prevalent in Denmark [10]

These interactions, documented o[n] videotape, were occasionally quite strik[]ing, particularly when the compute[r] would be referred to as if it was a[n] oracular "Magic Box". For example, "a mother brought her 2-year-old chil[d] for a check-up after pneumonia. Th[e] GP examines the child, then looked fo[r] a while at his screen, pointed to it, and said he is getting better, no doubt o[f] that". Even more frequently, the computer was used as a prop by the clinician to allow for interruption of the conversation with the patient. Whe[n] interviewed afterwards, most of the clinicians were surprised and uncomfortable with the way the computer seemed to intrude in their conversation. Similarly, patients were often mystified or annoyed by the interposition of the computer in the office, and also worried about the threat that it posed to their privacy. Other patients did believe that the computer helped their physician remain current and competent. Perhaps the most important lesson to be drawn from the study is that when computers become part of the clinician-patient conversation, it is important at the outset for clinicians to understand how it is changing their style of practice and to explain to their patients, the computer's presence and use. It also does suggest that when CPR's truly become ubiquitous the effect on medical care will likely be larger and different than we have expected. Perhaps, the best we can hope for is that if Dr. Schwartz's predictions are realized, the dialogue between physician and computer will always defe[r] to the patient-physician conversation

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