When the editors invited me to write this column, they allowed me a great deal of freedom—both in selecting a column title and in writing about things I care about. What fun! Actually, it took me a while to think of this title. I’m fond of alliteration, but the title is meant to be more than simply four words beginning with letter “I”. The title suggests what you’re going to find in this column in this and future issues. We will be discussing some of the latest in healthcare technology innovations, musing (perhaps ranting) about some of the large and smaller issues that we encounter in the effective implementation of health care technology, and the impact they have on clinicians, informaticians and patients. Ultimately, we may gain some insights from our reflections. I’ll try to distinguish the evidence from my opinions but, in the end, this is an opinion piece, so readers beware!

I’m very fond of Kim Vicente’s book, The Human Factor. In it, Kim suggests that the impact of technology innovations should be considered broadly in terms of its fit to the humans using it. He proposes the Human-Tech Ladder as a framework for our thinking about how we can best meet society’s needs for effective, efficient technology. The rungs of the ladder successively address the fit of technology to humans at the physical, psychological, team, organizational, and political levels. Kim offers powerful arguments about how

technology succeeds or fails in its mission when these five levels are considered—or ignored. Each rung of the ladder needs to be securely in place—and we need to ensure that this is the case at each step we take in the design, analysis, implementation, and evaluation process. The Human-Tech Ladder helps me reflect more critically on issues and innovations; and readers are forewarned that Vicente’s ladder is likely to reappear in future columns.

Let’s jump right in by considering the big hairy issue facing health care informatics currently: How to implement electronic health record Systems (EHRS) across the nation by 2014. Just writing the words makes my heart beat faster. What an exciting opportunity for informatics professionals! At long last the federal government has seen the light and is even offering to help pay for doing what we have been trying to do for a long time. So why is the scholarly community, especially members of the American College of Medical Informatics, not dancing with glee?

A number of issues are turning what might be jubilation over the government’s vision into a retreat into extreme caution by leaders of the informatics community. Why this response? First, we haven’t nearly enough qualified informaticians (nursing, medical, etc.) to lead the transformation. Well trained informaticians not only have informatics training, but they bridge the divide between clinical users and developers/vendors and information technology staff because they have feet in both camps. They can help ensure that the technology fits the clinical user because they understand the user’s workflow and clinical information needs and can help ensure that the technology meets both. Efforts to train additional informatics specialists through AMIA’s 10x10 series and other initiatives are laudable, but they have started rather late in the game and the numbers being produced are insufficient. However, the 10x10 program is an excellent way for health care professionals to transition into an informatics career.

For more details, go to the web site at https://amia.org/10x10 . The TIGER (Technology Informatics Guiding Educational Reform) project is an innovation that potentially can have high impact on informatics education in nursing because it has managed to involve virtually every nursing organization in the country and gain their commitment to providing all nurses with informatics knowledge and skills. In addition, they have developed a list of informatics competencies that each practicing nurse should have so that educators can use these as a guide. For more information on TIGER, or to become a part of this project, see http://tigersummit.com/Home_Page.php.

Second, our track record for successful technology implementation is not so good. In some institutions, the electronic health record has demonstrated improvements in patient safety, especially in the prevention of medication errors and adherence to evidence-based standards of practice. However, in many others the technology has produced unintended consequences. Excellent examples of those can be found in the research of Joan Ash and her colleagues. In a study of computer provider order entry (CPOE) along, these researchers reported unintended consequences related to changes and increases in the work staff did, changes in workflow, specific system demands for structured data entry and required data, changes in the communication patterns among staff, emotional responses, and ultimately dependence on the technology to the extent that work stopped if the system went down.

Do we know enough about what factors lead to positive and negative outcomes to ensure the former and prevent the latter? Can we anticipate and prevent the kinds of unanticipated consequences that Ash and her colleagues report? In the remainder of the editorial, I use Vicente’s model as a structure for reflecting on the EHRS challenge, starting on the bottom rung of the ladder (physical) and moving to the top (political).

**Physical.** One might think that input devices would be an easily solved issue. However, keyboards continue to challenge us in healthcare because they require considerable space, are not so easily disinfected, and not everyone types well. Natural language solutions still have not achieved their potential—and data entered via natural language can be difficult to retrieve for quality assurance or research purposes. The best device location for nursing continues to be debated. Do we put devices at the patient bedside so that nursing staff will have more patient contact or is that a barrier to thoughtful reflection and planning by the nurse or to patient interaction? The physical rung of EHRS needs considerable work to create a firm foundation for achieving our goal.

**Psychological.** One of our preeminent informatics researchers, Vimla Patel, has reported that medical residents described patients very differently when they were using structured or unstructured documentation systems. We found similar results with clinician’s descriptions of patient data when presented in an integrated object or as a bar graph. This suggests that there may be psychological aspects of the EHRS that we don’t yet understand—or even recognize. Structured languages have huge benefits in terms of being able to manage information in such a way that we can retrieve it to evaluate care or conduct research. In addition, structured languages

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can be used to trigger decision support or automate acuity metrics. However, more research is almost certainly needed on their psychological/cognitive impact.

One of the main benefits of EHRS is their ability to provide decision support to clinicians. For example, when a Hospital Information System is well integrated, it is relatively straightforward to provide an alert when a medication is ordered for which the patient has an allergy, when that medication interacts with the patient’s diet or other medications, or when laboratory values suggest a contraindication. However, it has not proved to be so easy to decide when and where to insert alerts—or even if they should be for all providers or only selected (e.g., novice) ones. Too many alerts lead to automatic overrides by clinicians. Too few may fail to prevent what could be preventable errors.

The way clinical data is presented continues to be largely as discrete data elements; although many of these can be graphed over time—and sometimes data elements can even be trended on the same page. But this is not sufficient for effective data synthesis. Nurses and other clinicians still have to pull all the data elements together to make a clinical decision. The cognitive work this entails is considerable. We need to do much better in displaying data in ways that are already integrated so that the meaning is easy to understand.

Social. It’s likely that we all have seen implementations of the same system that have good outcomes in one hospital—or in certain departments of a hospital—and fail miserably in others. Context makes a difference. With the exception of studies by Ash, Coiera and their colleagues, we lack systematic translation studies that can define the social and environmental factors that lead to success or failure of a particular informatics innovation. These early studies tell us that workflow differs across units and departments. The Emergency Department is radically different from Medical Surgical Units; and so are the Intensive Care Unit, the Perioperative Care Suite, and the Delivery Room. Although patient information must be integrated across all these areas and beyond, precisely how that is done within each area necessarily has to differ.

One of the most publicized examples Han and colleagues’ (2005) study of unexpected consequences at an academic tertiary children’s hospital health with a pediatric intensive care unit that received patients from a large part of the state. Prior to the HIS implementation, incoming critically ill infants benefited from a team approach that had developed a quick, effective chain of communication about their care needs from the ambulance to the emergency room and intensive care. By the time the patient arrived in the Emergency Department, staff were aware of the patient’s condition and

had medications ready to administer. When the new HIS was implemented, it broke that chain by disallowing any medications to be ordered before the patient was admitted. Instead of recognizing the differences in the workflow in the Emergency Department, the hospital, in an effort to save time, implemented the medical-surgical version of the software. The tragic result for some infants was a delay in getting the needed antibiotics in time to save their lives. Clearly one size does not fit all when it comes to ERHS implementation within a hospital.

We need to pay more attention to what workflow facilitates effective teamwork since patient care is never the job of a single person. Our own research has shown that teams are unlikely to be comprised of the same individuals each day. Instead, nursing staff, medical residents, pharmacists, dietitians, and others come and go on a regular basis. How well do our information systems support these virtual teams? Is information patient centered or discipline centered? What impact does each have on our ability to provide effective team-based care? How do our EHRS facilitate team-based care for the patients who need it?

Organizational. We recently conducted a cognitive work analysis of the nurse manager’s work environment in several hospitals. We found that the organizations in our study were consumed by the need to respond to a myriad of external constraints. The constraints were not only fiscal in nature, but also due to the growing number of quality and safety standards they must meet. New CMS standards that do not reimburse hospital acquired problems such as nosocomial infections patient falls have clearly gotten the attention of every hospital that treats Medicare patients.

We found that nurse managers were often the point persons to whom the organization turned to improve outcomes in their units or departments. However, the data that they used for their decisions was housed in a myriad of information systems that were not integrated. The lack of integration contributed to the complexity of nurse managers’ jobs and made it less likely that they would be able to synthesize the disparate priorities and issues into a coherent whole. Only if they can achieve that kind of synthesis will they be able to respond effectively to the challenges they are facing. Otherwise, they will continue to treat each new priority or issue as another fire to be stomped out before moving on to the next.

As a patient, I long for the day when I will only have to provide my medication list once and all my providers will have access to it; and each of my providers will review the history I provide online without asking me the same questions multiple times. I can

maintain an accurate list of my health problems and medications, but if I have to recall it on the spur of the moment I will undoubtedly forget something. For that reason, personal health records strike me as an ideal solution because I can maintain my lists in the privacy of my home when I am least stressed and most likely to provide an accurate record.

In Arizona, we were challenged by then Governor Napolitano to implement a state-wide EHRS. The strategy adopted to meet this goal has been more regional in nature. In Southern Arizona, the initiative has been broad-based, involving all the hospitals, pharmacies and a variety of other provider groups in the metropolitan Tucson area. The starting point will be to create a common medication list that will be shared across providers. The project has been remarkable for its ability to bring competitive organizations together to work cooperatively and share information with other groups in the state who are working their own designs so that ultimately the systems will be interoperable. A vendor for the Southern Arizona effort has been chosen and I’m anxiously awaiting implementation.

Political. It is unfortunate that implementation of the EHRS has become so politicized. It is seen by some as the savior of healthcare reform and by others as an expensive violation of personal privacy. It is likely that neither side is sufficiently informed about the advantages and risks to make truly informed decisions. Informatics professionals are participating in efforts to develop common standards and make recommendations about implementation.

Among these groups, the American Medical Informatics Association has tried to provide evidence-based information so that control of the project is not biased toward vendors. Many other informatics groups are involved as well, which is critical to the success of the effort.

In sum, we have a great many challenges if we are to realize the goal of implementing and connecting EHRS throughout the country. It’s an exciting time for informatics—but it is also a daunting challenge. This reflection is on the state of the national EHRS implementation using Vicente’s Human-Tech Ladder as a guiding structure may give you an idea of the kinds of things we’ll be discussing in this column. I’ve described some of the issues that surround potential EHRS innovation throughout the country and the potential impacts from a physical, psychological, social, organizational and political point of view, using both experience and research evidence to make the points.

If I’ve stimulated your own ideas, broadened your perspective, tweaked your curiosity about a study, or even raised your hackles, I’ve accomplished my goal. I’d

love to hear from you so feel free to contact me at the email address listed.

References


