lot of money—most textbooks in the United States cost at least $60. Textbooks often require an expansion card for storage. Finally, you may find an expandable keyboard useful—this folds to the same pocket size as the handheld but unfolds to match a full size keyboard.

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# The clinician's perspective on electronic health records and how they can affect patient care

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Many attempts to get clinicians to use electronic health records have failed, often because of difficulties with data entry.[1-4] Technology should complement and improve clinical care, not impose extra burdens on already overloaded medical staff. The clinical "usability" of electronic records systems is particularly relevant with the recent appointment of service providers to implement the national Integrated Care Record Service for the NHS as usability also affects patient care. I examine important lessons learned from previous attempts to get clinicians to use computers in health care; discuss how clinicians actually work; make recommendations on designing or selecting clinical computer systems; and explore how the use of electronic health records might affect patient care.

## Summary points

Narratives are essential to a patient's episode of illness

Poor communication is more often detrimental to patients than lack of knowledge

Computers should enable clinicians to capture narratives easily

The structure of the patient's record strongly influences the ease of information retrieval

## How clinicians work

### Use of narratives in clinical reasoning

Patient documentation systems that try to reproduce previously accepted models of clinical reasoning (pattern recognition, algorithms, or hypothetico-deductive models) have achieved limited acceptance. According to Greenhalgh, the medical encounter consists of stories within stories.[5] Kay and Purves maintain that narratives are at the heart of clinical decision making and refers to this concept as "narrative reasoning."[6] They argue that "every patient tells a story (narrative) and clinicians intuitively use narrative devices in relation to the delivery of patient care." The patient is seen as "a page from the book of nature, a text to be read," and the doctor becomes the author of "stories within the medical record." Kay and Purves make a strong case for retaining information in a conceptual framework and maintain that this is best accomplished by means of narratives rather than "reducing the semantic richness and degrading the story to limited codes and weakly connected phrases."

Van Ginneken also states that many computerised medical record systems are rejected by clinicians because they are not based on a story metaphor.[7] Frisse and colleagues state that "using conversations as a central metaphor for handling patients' records reflects work flow in a clinical setting" and that "until recently, shortcomings of medical information systems software, computer-human interfaces, and networks forced upon the healthcare community a depersonalised notion of 'information' centred upon the interaction between the individual and the 'system' rather than upon the interaction of human beings with one another."[8]

### Impact of construction of patient record on clinical insight

Berg argues that, to a large extent, compiling a medical record is a sociological process not a cognitive function.[9] Traditionally, the work of clerking a patient was seen as collecting observations, testing diagnostic hypotheses, and reaching treatment decisions by means of logic. Berg maintains, however, that creating the medical record is a "moulding process in which the patient and his situation are reconstructed to render them manageable within existing agency routines." The clinician tries to transform the patient's narrative into an entity which he or she is familiar with and capable of managing. In this process, some aspects of the story are emphasised and others forgotten. The process of creating a patient record changes the clinician's concept of the patient's illness episode. Berg further maintains that failure to appreciate this sociological aspect could par-

tially explain the current paucity of fully integrated, clinically useful electronic records systems.

### Conversational interaction between clinicians

Coiera states that most medical interaction is driven by a conversational paradigm, and he points out that communication errors cause twice as many deaths as inadequate clinical skills do.[10] He argues that this is where "substantial informatics efforts need to be focused," and he adds that "direct support of the communication between clinicians should substantially improve how our organisations acquire, present, and use information." A patient's computer records should promote seamless transfer of care from one clinical team to another. This is best accomplished by using a conversational or narrative format rather than chunks of information scattered around divergent screen pages.

### Problems in entering data

Data entry has always been a major obstacle to healthcare professionals' acceptance of electronic records. Most input makes use of structured data entry, where the user has to select relevant clinical terms from a predefined list. This is restrictive, and extracting this information from a narrative requires more work from the clinician. Also, entering structured data can subtly change the meaning of the item coded. Furthermore, creating a standardised clinical set of terms and keeping these up to date is resource intensive. Rather than placing the burden of coding on the doctor, the developers of electronic records systems should be "more oriented towards creating tools that support medical work as a social, interactive process."[11]

Despite much effort to produce friendlier interfaces—including pen based, hand held computers,[13] touch screens, and other forms of structured data entry—no generally accepted computer interface has emerged for capturing data. The fastest method for
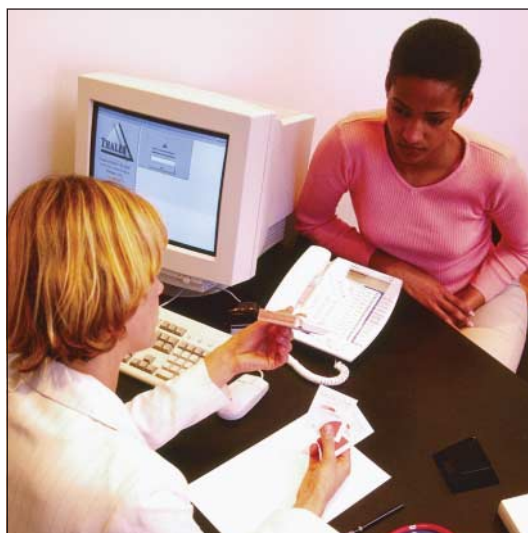


Patients generally accept the use of computers in clinical settings

data entry is speech input, but the quickest way to assimilate information is reading structured text.

### Ease of access to and structure of records

Reading text on a computer screen is up to 40% slower than reading printed text. If the computer is used to generate output, the layout and structure of the reports are important as this can influence clinical decisions in sometimes fundamental ways.[14]

Coiera states: "It is possible for a well-designed set of paper forms to be far more effective in improving the quality of a medical record than a poorly designed computer-based one."[15] Despite the ease of creating paper based records, they prove difficult to search. Tang and colleagues found that their physicians could not find relevant patient information in traditional paper based records in 80% of outpatient visits.[16] The ease of using computer based output as opposed to the benefits of generating printed reports must be weighed.[15]

There are obvious benefits of having data available electronically, but having appropriately structured printed output is still far easier for browsing, reading, and finding information. A paperless environment is not necessarily good or desirable. Having the option to use either paper or electronic record output, depending on preference or other clinical constraints, is important.

## Clinical perspective and potential benefits for patients: practicalities

### Capturing the patient's narrative

Data should be acquired as close to the source as possible.[17] The ideal electronic records system should allow the clinician to input narratives effortlessly using handwriting and sketches as well as speech input at the patient's bedside or at the office desk. Some coding by clinicians is unavoidable but should be limited if possible to the problem list (diagnoses) and procedures. Kay and Purves propose a clinical approach in which doctors improve their communication skills and allow "each actor responsible for observations and actions within the patient's care pathway … to record the pertinent information."[6] Van Bemmel and colleagues state

that coding of data should be done "only if there is no other way to present the data" and preferably "by the person making the observation."[17]

Several studies have found that computer use in clinical settings has generally been accepted by patients, whether in general practice surgeries,[18 19] outpatients departments,[20] or examination rooms.[21] No degradation of the doctor-patient relationship was noted in these studies. A greater emphasis on patients' narratives should be beneficial: "Patients who are fully able to share their perspective often achieve better outcomes."[22]

### How constructing the electronic record affects clinical insight
Handwriting is automatic—you don't have to think about it—but for most people, using a computer is not. Consequently, the cognitive load associated with documenting the details of a patient encounter is smaller if the clinician writes them by hand rather than entering them on a computer. Handwriting potentially allows more thought for focusing on how to diagnose and manage the patient's illness. Clinicians using computers could have more of a cognitive load and would benefit from having tools that stimulate clinical reasoning—such as differential diagnosis, prompting, reminders, mnemonics, algorithms, references, risk calculators, decision trees, and best evidence resources. These are almost impossible to build into conventional handwritten notes.

Creating the relevant supportive knowledge structure in an electronic environment is also not easy. Great care is needed when integrating such aids into the clinician's workflow as they could easily hinder rather than benefit patient care.[23] The recent development of digital pens that record and transcribe handwriting—such as those made by Logitech (www.logitech.com) and Nokia (www.nokia.com)— might reduce the cognitive load while providing an automated link to electronic aids. Making the right connections with local and national guidelines, stimulating wider thought about the case, and supporting clinical decisions with the best evidence are extremely important elements for patient outcomes. Much more research in this area is needed, however.

### Communicating clinical data by voice
Current technology could easily handle voice on hospital networks or the internet. Some information is important to have in written or printed format to avoid ambiguity. The problem list (diagnoses) probably falls into this category. But much of what clinicians do has relatively shortlived value—for example, "to do" lists and instructions to others. Why not send a recorded request for a consultation across the network rather than fax a handwritten one? The electronic records system could easily incorporate multiple audio files along with the usual textual data. The audio files could be searched using an "audio mining" engine (www.scansoft.com/audiomining). The admitting doctor could record a summary of the patient's admission for the next day's ward round. Recordings could be replayed and critiqued. If required, any good quality voice recording could be transcribed using software or by a secretary. Far more use could be made of asynchronous communication

> **Speech: easy for data entry**
>
> "Speech is natural—we know how to speak before we know how to read and write. Speech is also efficient—most people can speak about five times faster than they type and probably ten times faster than they can write. And speech is flexible—we do not have to touch or see anything to carry on a conversation." Zue[24]

to reduce interruptions. Using the computer to facilitate communication by clinicians should directly improve clinical outcomes.[10]

### Facilitating data entry
Making data entry as easy as possible is essential if we want clinicians to use electronic means to enter and share accurate patient records on a national network.

The easiest way to enter data into an electronic records system is to use speech, followed by handwriting and then typing (if you are not a touch typist). Capturing speech would promote the collection of narrative rather than discrete bits of data. Transcription could be used if required. The recording could be sent through an audio mining engine to index the words it contains and thus facilitate access to its otherwise "invisible" contents. As yet there are no commercially available electronic health records systems that capture voice recordings as a source document.

Another important consideration is that medical work is driven by interruptions. Software needs to be able to keep its state when the user is diverted to a telephone call or query and somebody else takes control of the computer or terminal to continue a task they were busy with before being interrupted themselves.

### Need for easy data access and interpretation
It is quicker to retrieve and assimilate information by reading and scanning than by listening to speech. Reading printed material is quicker than reading the same text on a computer screen. However, although paper records are easy to create, they can be difficult to search—particularly if they lack structure. Tange and colleagues found that data retrieval from medical narratives is highly dependent on the granularity of paragraphs used (that is, the number of labelled segments of text). They concluded: "Most benefit can be expected from medical history and examination notes divided into organ systems and progress notes divided into problem segments."[25]

How information is presented (its context) is an important factor affecting data retrieval and interpretation. Computer systems should be capable of producing well structured screen based and paper based output of narratives. Graphic output of numeric data using visual indicators of normal ranges rather than endless columns of numbers would improve their interpretation.

Improving retrieval and assimilation of existing information on patients can reduce duplication, improve comprehension, provide a more holistic view of the patient, and alert clinicians to potential conflicts in management.

## Future challenges

The relatively fluid process of patient management often does not match the rigidity of most electronic health records systems. Medicine is far from a factual science, and patient management requires a tentative, evolving reinterpretation of previous data in the light of new information. Most interaction between clinicians comprises narrative (free text). Narrative contains more information than isolated or coded words. Most electronic records, however, rely on structured data entry. The drawbacks of this approach have been summarised by Powsner[12] and de Lusignan and colleagues.[26] Read codes are less accurate at capturing general practice concepts.[27]

There is great pressure to reduce patients' length of stay in hospital. At the time of discharge, computer generated summaries can be produced more quickly than dictated summaries and so improve communication with primary care.[28] The pace of modern practice dictates the use of technology, but the lack of direct clinical input in the development and procurement of information technology has been cited as a major factor in the failure of many clinical information systems. Replacing paper with electronic records will change medical practice, including relationships between doctors and nurses, responsibilities, and work distribution. Clinicians need to be closely involved in ensuring that software for documenting patient encounters complements the way they work.

Patients already have the right of full access to their electronic records for "any or no reason," says Goss; his article provides an interesting view of the difficulties associated with patients' access to health records.[29] By June 2004, some patients should have "direct" access to their electronic records in hospitals and in primary care.[30] From the clinician's perspective, however, the words of Scott McNealy of Sun Microsystems ring true: "You have zero privacy anyway. Get over it."

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## The door handle sign

She had been to see me several times during the previous few months with a variety of minor and seemingly insignificant symptoms. This occasion was no different; she had a minor degree of hallux valgus, a runny nose, and some contact dermatitis on her wrist. She was, however, clearly very unhappy, but I could not discover an underlying cause. After a long and unsatisfactory consultation, she left my consulting room leaving me aware that I had failed to meet her need. Fortunately, as she closed the door behind her, I noticed that the handle continued to turn unnecessarily two or three times.

I followed her into the by now crowded waiting room and asked her to come back. "I think there is something you haven't told me," I said. Immediately she burst into tears and started to undo her dress. Her chest was swathed in purulent bandages, which covered a gangrenous breast carcinoma en cuirasse.

The relief was immediate and enormous. I don't know how she had managed to conceal this from her husband for so long. I don't think my failure to make a full examination on her first visit would have altered the prognosis, but it was a salutary lesson not to write off every seeming hypochondriac. Despite the dire situation, my subsequent consultations and visits were very rewarding.

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