

Cover Story

A Blueprint on How a Special Computer System Can Create an Automated Clinical Assistant For Dialysis Clinics

By Elizabeth A. Evans

“The ability to easily analyze aggregate patient data is to interchange the clinical concept of ‘from bench to bed’ with its inverse—‘from bed to bench.’ Using the system as a clinical assistant, the scope of medicine expands its practice as it becomes more closely aligned with the practice of information.”

Introduction

Twelve years ago, when AMI Healthcare Systems Group first stated that a Clinical Information System (CIS) should be an automated assistant to medical personnel, the most common reaction was skepticism. Today, this idea is considered mainstream. The automated assistant concept, however, is not simply an add-on feature to a CIS. It is possible only when the CIS development team integrates it into the system’s design at its inception using the appropriate technology and concept architecture. Some of the basic components of this kind of CIS are:

- Minimally intrusive data collection that uses a standard coding structure with a common meaning so that a code may be used across diverse disciplines without compromising its explicit definition;
- Patient-condition, real-time alerts, and protocols delivered at the point-of-care that are based on the coordination of data to disease management; and
- Automated knowledge discovery tools that analyze and quantify data in order to report outcome information about patient populations.

Purpose and Methodology

The objective of this article is to explain how these components contribute to creating an automated medical assistant. To meet this objective, we use a simplistic approach to anemia management, namely, tracking applicable lab and treatment data, as seen from four viewpoints—the physician, nurse, lab technician, and patient. Although they may weigh many factors, we will consider how each may use only hematocrit (HCT) data in their scenario.

Viewpoints

A *physician* should be able to trend the patient’s HCT over time, be immediately alerted when it varies from the guidelines, and track the efficacy of erythropoietin (EPO) therapy in real time. A physician should also be able to quickly retrieve and review medical notes relating to the patient’s anemia, whether the relevant data is stored as coded data or free-form text.

A *nurse* should:

- Have the patient’s current HCT in order to follow the protocol specific to anemia at the time of the patient’s visit;
- Be alerted without delay when the HCT varies from the protocol-allowed variance; and
- Have on-line and immediate access to the relevant protocol.

To provide automated test results across medical disciplines and to the patient, the *lab technician* must know that the standard code for hematocrit is HCT.

Finally, using secure and real-time data, the patient and the family will want to know whether current therapies are achieving the desired outcome. Each

scenario uses the patient's HCT in a slightly different way. The standard code—HCT—mandates that the results retain their relative and absolute values.

Data Collection

Collecting data in a standard format so many can retrieve it in meaningful ways has been a continual obstacle in Medical Information Technology (MIT).

For purposes of this article, there are two kinds of data collection: automated and manual.

Automated Data Collection (ADC)

The use of an industry-standard interface format like HL7 is pivotal to automated data collection. The data typically identified with ADC in a dialysis setting are data to and from testing laboratories.

Other contributing entities include hospitals, medical equipment manufacturers, physician offices, and intermediaries. ADC requires no effort on the part of medical personnel.

The TIME System

The MIT challenge is to structure and codify manual entry so entry time is decreased, record accuracy is increased, and data retrieval is intuitive and efficient.

As a means to accomplish this, a technique for entering medical notes into its CIS, the TIME System—Total Information for Managing Effectively—was developed. The Formatted Text Notes (FTN) technique, links coded entry with free-form text and connects the entire note to the patient's specific disease(s) or event.

Because of this linkage, authorized medical personnel may quickly retrieve a FTN and all its references. Over time, FTNs become a virtual chronological charting history.

Patient-Focused, Real-time Alerts and Protocols

One of the benefits of coded, structured data is the ability to link data points within a single clinical event or a particular dis-

ease. The TIME System lets medical personnel set up their own data points as a disease profile such as anemia, each with outlier ranges and/or actionable trends. It then tracks them individually and collectively. As such, the profile of a disease in the System may incorporate specific protocols, medications, test results, vital signs, medical notes, and other relevant data. The anemia profile

Lists, alerts, and appropriate protocols—at the point-of-care or at inquiry—when a threshold is reached.

A benefit of the clinical profile system is timely intervention when subtle changes occur instead of waiting until a more obvious symptom or syndrome emerges. Using data in this way enables the physician, the nurse, and the patient to manage by

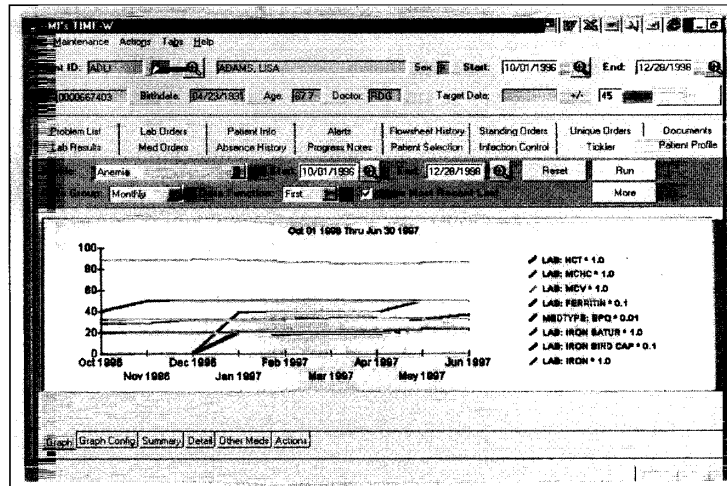


Figure 1. Sample of an actual patient Anemia Profile.

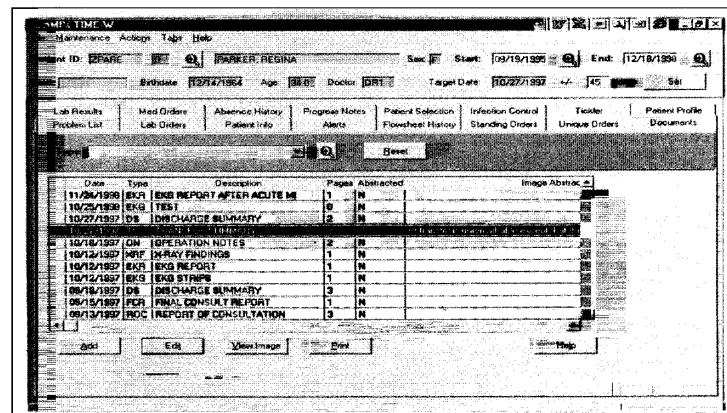


Figure 2. Scanned documents from diverse sources. Refer to Figure 3 to view the highlighted transfer summary.

would include data points for EPO and iron dextran medications, HCT or hemoglobin, aluminum, iron saturation test results, and notes. The System actively tracks their data aggregates and dynamically reports them in real time with To Do

exception and enables each to focus their attention on avoiding adverse clinical events.

A Case in Point

A physician who receives an alert about the patient's HCT would click on the Profile tab and

select the desired date range for the anemia profile. The System then graphs the anemia parameters over the selected date range and separately tabulates the results on the graph (see Figure 1). To study in detail the effect of EPO dosing on the patient's HCT, the physician clicks on a specific

recommended action, including follow-up lab tests, and directs the nurse to take specified action(s) based on the results in the anemia profile. Then it notifies the attending physician of each new order per the protocol that the nurse enters for the patient and those entered as a verbal order in

data in pre-set and custom-designed *views*. Medical personnel may use "views" with great ease and with almost no training, entering their own criteria in virtually the same way they update a simple web form. With some training, they can learn how to write their own data reports and use off-the-shelf programs and AMI-programmed aggregates. In both pre-set and custom-designed report cases, standard statistical tools structure the data and widen the scope of analysis.

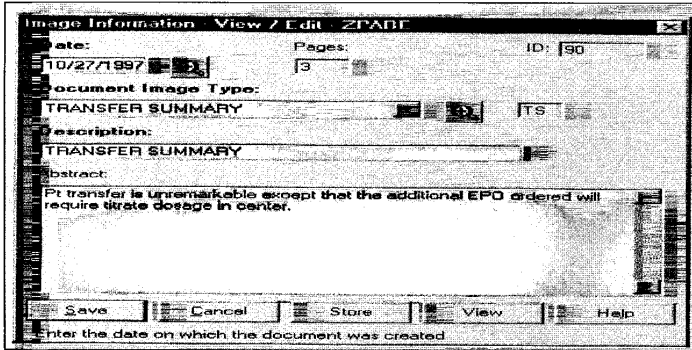


Figure 3. The AMI Traction Screen, when medical personnel click on the Abstracted field shown on the Scanned Document Management screen.

HCT data point on the graph and then on the Lab Results tab. The actual HCT results that correspond to the selected date-range point on the graph appear. To research further, the physician clicks on the FTNs. Those that correspond to the selected date range are displayed. The physician may choose those associated with anemia or with other problems by using the disease profile filter. He/she then clicks on the Document tab, peruses the types of documents within the same date range, reads the one-line summary of each (Figure 2), and then picks the most recent transfer summary to read the details (Figure 3). The last step is an order to change the EPO dose and a note to the patient's primary nurse.

The nurse receiving the physician's note and the alert about the patient's HCT could click first on the dialysis adequacy profile, then on the anemia profile to check the critical data points, followed by the protocol button for specific information about the anemia protocol. The System displays the entire anemia protocol with the guidelines for EPO dosing and

response to the physician's note.

The lab technician who receives the lab order—almost as soon as the physician and/or nurse enters it—begins processing the blood without delay when the lab receives it because the paperwork has already been completed online. The lab results are automatically entered into the patient's file, and the data is available to authorized medical personnel and the patient. In a limited and specific sense, the circle of care is closed.

Automated Knowledge Discovery Tools

The ability to cross-relate aggregate patient data is the basis of data warehousing technology and the foundation of an automated knowledge discovery tool. The medium is data, standard in format and meaning, and, within this technology, neutral in the context of its useability. Previously constricted to a patient-specific focus, the use of the data expands to patient-population and cross-patient-population inquiries and analyses.

A data warehouse, *Inter-Data, Information Direct (ID²)*, retrieves

Conclusion

Linking patient-specific data with real-time alerts and protocols at the point of care or any time is to give birth to an automated clinical assistant. Beginning with this end in mind is the only way system developers are able to realize this objective.

To take this one step farther, the ability to easily analyze aggregate patient data is to interchange the clinical concept of "from bench to bed" with its inverse—"from bed to bench." Using the system as a clinical assistant, the scope of medicine expands its practice as it becomes more closely aligned with the practice of information.

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