Automating Clinical Documentation in Dentistry: Case Study of a Clinical Integration Model

Patricia S. Button, EdD, RN; Karen Doyle, RN, MSN; J. William Karitis, DMD, MA, MPH; Charles Selhorst, RN, BS

Writing in 1973 about automating dental records, S.W. Sharkey and J.M. Murison observed: “What is difficult is to design a method of entry to the computer which can be easily used by the dentist and his assistant, and which can also provide a possible back-up record system.” For Sharkey and Murison, the prevailing technology consisted of mark-sense systems, or punch cards. Computers, at that time, occupied entire rooms and the first personal computers were still years away.

A quarter century later, the several technical barriers (hardware and software) once thought to preclude such automation have been overcome, and the challenge identified by Sharkey and Murison is being met. Implementation of a user-friendly automated dental record is now taking place at several dental clinics within a military health care system. This automated record has the ability to process the types, amounts and sequencing of information that dentists use in making clinical decisions.

The success of this implementation is due in part to a user-focused clinical integration model. In this particular model, clinician workflow is studied, documentation templates based on that workflow and end-user input are developed, case-based training is conducted, and users are supported during initial use. As a result, clinical users feel comfortable with and invested in automation, leading to user acceptance. This clinical automation project includes a documentation application that enables dental clinicians to capture, record, and access patient data in real time at the point of care.

By implementing the notewriter under this model, this military healthcare system is working towards the goal of a computer-based patient record (CPR), while ensuring that the dynamics of its dental practices drive the automation of documentation. Use of the model has already revealed significant differences.
in work flow between the practice of medicine and dentistry; lessons which have direct implication for automating those work-flow processes, and in turn, for improving health care delivery.

This case study is organized as follows:

- Literature review of the use of automation for clinical documentation in dentistry
- Overview of the clinics involved and the automation tool selected
- Description of the use of a particular clinical integration model to implement automation
- Lessons learned from initial use of this model (essential differences in work flow between general medicine and dentistry)

**Automation for Clinical Documentation in Dentistry**

Though technology has advanced greatly since Sharkey and Murison’s time, and the advantages of decision support systems have increased considerably, a literature review shows that dentistry has been slow to automate for clinical purposes. To date, most automation systems used by dentists are for practice management purposes (such as accounting, expenses, and insurance; also scheduling, inventory, and word processing). In fact, dentistry actually lags behind other healthcare fields in the recording and use of clinical data.

This “clinical automation gap” can be attributed to both professional and technical factors. First, dentistry lacks prevailing standards for content and format for both the graphical chart and written consultation components of patient records. Second, software limitations have prevented the incorporation of clinical dental computer systems into practice management solutions.

There is also great variation among dentists in terms of the categories of information recorded and the level of detail collected in the patient record. To account for these variations and provide system flexibility, Bailit and Truax (writing in 1990) suggested several strategies:

- Allow for the collection of data in any sequence (for example, tooth charting can be completed before or after taking a medical history)
- Offer users the option to delete or add whole screens
- Allow users the option of using the term “chief complaints,” while also allowing them to delete or add reasons (“complaints”) for seeking care
- Provide menus to speed charting

Recent studies, however, indicate that dentistry is beginning to close the clinical automation gap. As baby boomers age, and the focus of dentistry shifts from acute care (where a paper-based patient record has been adequate) to an increasing concentration on chronic care, the CPR will become a desirable tool. Some experts even see the clinical workstation as “the integrating
centerpiece for a variety of clinical-based technologies that are emerging in the health professions.”

One Step Closer to a CPR

In its landmark 1991 report, the Institute of Medicine articulated its vision of a computer-based patient record. It is a vision that the military healthcare system is beginning to realize through a number of interrelated activities. One such activity involves three dental clinics. For this project, the military defined a program for a computer-based clinical information system to acquire and maintain both medical and dental records. In this fashion, such a system would also inform dentists about life-critical, patient-specific information (for example, the need, in some cardiac patients, to administer antibiotics prophylactically before certain dental procedures). To execute this program, the military called for a documentation tool that would automate such data; that is, a notewriter. A structured documentation tool was selected (for this study, Oceania Notes was selected). This notewriter is now being deployed in all three clinics (with four practitioners each, for both general and comprehensive dentistry).

The notewriter is a software component designed to record clinical observations and administrative information. The database of this application contains coded, structured terms and phrases that describe millions of clinical expressions, the use of which can speed clinical note construction. These phrases and expressions are extracted from the clinical knowledge database and used as part of templates (preprogrammed wording elements that are used to speed the charting process). By providing information that a user can accept or edit, templates eliminate redundant entry of clinical findings, protocols, standard instructions, and other routine assessments. An example of a notewriter template designed for documenting routine endodontic examination is shown in Figure 1.

In addition, templates can be designed to capture several standardized nomenclatures, including ICD-9, ICD-10, CPT 4, and ADA. Because templates can be structured on several levels (national, regional, institutional), they can serve as the basis for standardization of assessment, results, and treatment plans (and even provide input into billing systems).

Effective templates for patient encounter share three attributes:

- Focus on the appropriate scope of the particular practice
- Improvement of work and information flow
- Capture of data needed for benefits realization

Focus on Appropriate Practice Scope. Templates support the documentation needs of various types of healthcare providers (for example, dental assistants, hygienists, dentists) within a given practice. For example, the note used by an oral hygienist would differ from the note a dentist would use. Templates,
Improvement of Work and Information Flow. Templates standardize the way information is entered. For example, a clinic may require that the blood pressure of every patient is taken and that the medical history is reviewed. The work flow—information flow issue is ensuring that every provider entering information into the record does so in a way that is consistent both with their role and the work flow of the clinician. The template is created in a way that standardizes the data elements being merged from the input of various providers into the dentist's note.

Capture of Data Needed for Benefits Realization. This third attribute provides a benefit that has become increasingly burdensome to realize in the paper-based environment. For example, all clinics in this federal government healthcare system identified a need to streamline collection of ICD-DA codes. To help with this matter, consultants worked with users to validate the appropriate procedure or diagnosis, and then make that information part of the template in such a way that the appropriate code would be generated.

Using a clinical integration model, clinical consultants work with clinician end users to ensure that each of these attributes becomes a part of every note, therefore, are constructed so that each note is tailored to the specific work flow of the provider and the specific data he or she typically records.
template. Because of this collaboration, templates become powerful tools for textual documentation. For example, dental technicians are spared the tedious process of coding for dental procedures.

**Using a Clinical Integration Model to Implement the Notewriter**

A clinical integration model is a dynamic, user-focused framework that guides the implementation of an automated application to support clinical documentation at the point of care. Over the past fifteen years, collective experience has shown that the activities in this model are successful strategies for implementing automation and ensuring end-user buy-in.

The clinical integration model described in this case study involves five activities. Each of these activities has been proven to increase the likelihood of clinician acceptance of application use, and capture of meaningful clinical data. These five activities are:

- Work-flow analysis studies
- Template development workshops
- Template validation and verification workshops
- Incorporation of work-flow analysis studies and template workshop findings into training scenarios
- Implementation assistance and template revision

As this article goes to press, the healthcare providers at this military healthcare system are completing the template validation and verification activity. Therefore, this study will discuss what occurred during the first three processes and what is expected to occur (based on past use of the model) during the final two.

**Work-Flow Analysis.** Work-flow analysis studies aid in identifying the information flow of clinicians at the point of care, and relate that flow to the integration of new technology into their clinical processes. These studies (which are preliminary to developing templates) involve four components:

- Onsite interviews, and observation of clinicians at their clinical workspaces
- Collecting copies of chart entries and forms
- Identifying steps in clinical processes
- Comparing clinical process steps to changes that will occur with automation

For this project, work-flow studies were conducted at seven dental clinics. The primary objective of those studies was to obtain enough data to identify possible changes in workflow caused by automation, and present users with working (prototype) patient encounter templates. Interviews were conducted with dentists, registered dental hygienists, and dental technicians...
to define the topics and content for the dental templates. Among the topics covered were dental encounters relating to the routine examinations, procedures, and dental prophylaxis. (Examples of the types of data collected were previously given in the description of patient encounter templates). Copies of chart forms and chart entries were then collected from the clinics. The data gathered from this stage was then used to influence system configuration. This data collection involved two clinicians spending one half-day each at the dental clinics observing and interviewing clinicians.

The work-flow analysis performed for this healthcare system revealed a key configuration requirement. Although the notewriter includes a comprehensive clinical content knowledge base for medical specialties, additional content was needed for dental specialties. Numerous samples of dental records and dental forms were reviewed to identify terms as well as specific documentation needs. Consultation with practicing dentists was then obtained to review, modify, and determine the adequacy of the dental content. As a result, the necessary content was added to the database.

**Template Workshops.** Following work-flow studies, two types of template workshops are generally held. During the first workshop, a few selected clinical representatives or internal champions focus on refining the draft templates. At the second workshop, as many clinicians as possible review those templates. Because template development is, of necessity, an iterative process, several workshops must be held.

For this project, five template development workshops were conducted with representative dentists, registered dental hygienists, and dental assistants in the areas of general dentistry, comprehensive dentistry, prosthodontics, and endodontics. These two-day workshops focused on designing templates to support the practice of general and comprehensive dentistry. Workshop activities included project briefings, notewriter training, small group critique, online editing of the templates, and consensus building regarding template topics and content.

**Template Validation and Verification.** After the initial workshops, a comprehensive review of the templates is conducted. The review for this project involved the providers designated to use the notewriter in the application’s alpha test. Three clinics were selected to test the application. During December 1998, consultants worked with providers in each clinic (that is, with every dentist, registered dental hygienist, and dental assistant) in reviewing and editing the templates.

**Training Scenarios.** As implementation continues, information obtained from the work-flow studies and template development workshops is used to help trainers incorporate clinic-specific examples into their presentations. In other projects in which training has been designed and implemented using work-flow study data, increased user acceptance and adoption have been reported.
Implementation Assistance and Template Revision. As noted, template development is, by its nature, a continuing and iterative activity. Since this particular project allows for just-in-time revisions (based on user feedback and consensus from the other users), a revision scenario might become a part of the final activity.

Lessons Learned: Differences in Work Flow as Reflected in Patient Encounter Documentation

Though implementation of the notewriter is still underway, the clinical integration model is already yielding several valuable lessons. Each of these lessons has important implications for moving the military healthcare system toward its goal of a CPR, and for moving the practice of dentistry toward use of automation for clinical purposes.

The work-flow analysis of the dental patient encounter revealed differences between medical and dental patient encounter documentation. These differences were found in several categories:

- Documentation required for reimbursement
- Nature of medical versus dental examination (including the degree and sequencing of content typically recorded during an encounter)
- Development of a treatment plan

The differences had direct implications for both the content of the knowledge base of the application, and the format and content of the templates. Specifically, components of the dental treatment plan were added to the application menus and branching options were configured to match dental work flow.

Reimbursement. In the medical profession, reimbursement is based on diagnosis codes (ICD-9) and procedure codes (CPT 4). Medicare reimbursement rules (the guidelines by which private payers develop their rules) require physicians to provide evidence of a level of documentation (that is, the diagnosis code) appropriate for the attached billing code. In the medical model, a certain granularity of a physical examination must be documented in order to use a certain billing code. These requirements have provided a strong impetus for the medical profession to provide documentation that will support appropriate reimbursement.

Such requirements are not yet true of dental reimbursement policies, where third-party reimbursement is based on submission of procedure codes. Traditionally, the chairside dentist has not felt compelled to chart a dental diagnosis. Consequently, different standards exist for billing (and thus documentation) between medicine and dentistry.

For the clinics in this study, an enterprise-level decision was made to begin the process of documenting dental diagnoses with each exam. Dental templates
in the notewriter application support the capture of dental diagnosis data. Each template for the documentation of a dental exam was designed to have an area for quickly documenting the dental diagnoses associated with the findings of the dental exam.

**Examinations.** A second set of differences pertains to the way information about a patient is communicated and recorded during a patient encounter. During a medical exam, a physician will generally note a finding such as pain or swelling first, and then note its location such as “left lower extremity.” During a dental exam, the information is relayed in the opposite order. The dentist first notes the location—tooth #1, #2—and then findings about each tooth—for example, dental caries or staining.

During the template development phase, dentists in these clinics tried to “fit” their method of recording information within the preexisting, medically oriented docschema (layout of menus) of the notewriter. Dentists discovered that the notewriter’s sequencing did not reflect their work flow. They would open to the section “History and Physical” and select “Physical Exam” to enter information. The branching schema under physical exam, however, allowed information to be recorded only in a predefined sequence: “findings,” and then “location.” Dentists were “forced” to write “dental caries #1, #3, and #7” or “staining, #1, #2, #3.” Many reported that the process was too cumbersome. To remedy this matter, dental clinical content was designed with its own schema, thereby enabling dentists to make tooth-by-tooth location recordings (for example, #1, dental caries).

These changes, however, did not address the larger issue of diagnostic charting and dentistry’s dependence on graphics. Textual documentation of hard tissue (tooth) findings is rarely performed. Even the most sophisticated software products on the market are no substitute for an efficient dental assistant using a paper form. Currently this military health care system is considering integrating the notewriter with a graphical charting system.

In contrast, textual documentation is necessary for recording dental procedures, and here the application offered several advantages. Typically, dentists make shorthand notations of methods and materials used during a procedure. By using templates to complete this documentation, the process was expedited substantially. In addition, by developing these templates in a collaborative setting, consensus building among the various dentists was generated and an institutional standard of dental documentation introduced. Though the process of creating the templates was sometimes tedious (and repetitive), the dentists’ showed a clear collective enthusiasm for this standardized automated documentation.

Another difference was found with regard to sequencing. In dentistry, problems are identified on a “per tooth” basis. In medical exams, the entire body is examined and problems identified after the patient encounter.

**Treatment Plan.** A third area of difference between medical and dental charting pertains to the development of a treatment plan. In the dental profession, the treatment plan that is developed during the initial examination is
regarded as the cornerstone of a comprehensive, long-range plan consisting of interrelated steps. Each step of the dental treatment plan is related to the preceding and the following steps. It reflects the prioritization formulated during the initial exam. At each subsequent patient visit, it is often the treatment plan that provides guidance in determining which treatment is to be performed next. The dental treatment plan is a treatment roadmap for the dental clinician.

This contrasts sharply with the role of the treatment plan in the medical model. The medical treatment plan is generally a plan of care for the patient to follow. After evaluation by the medical clinician, medications are often prescribed for the patient, activity levels defined, and follow-up care instructions provided. These components frequently constitute the medical treatment plan. They are a roadmap for the patient.

With this background in mind, it is possible to appreciate the documentation needs of the dental treatment plan. One method of documenting the work to be performed (and the one used by dentists at these clinics) uses two graphics of teeth. One graphic is an “inked-in” and therefore permanent record of the historical treatments and restorations. The second graphic is a “penciled-in,” less-permanent representation of the work to be performed, clearly visible within the chart and serving as a guide for any other clinician who may deliver care to that patient. As the treatments and restorations are completed, and marks transferred to the ink version, the corresponding marks on the pencil version can be erased. By contrast, the medical profession would find unacceptable documenting a clinical record in pencil.

The two professions also differ within the patient chart in how the problem is linked to the description of the procedure. When a dentist writes a procedure, the procedure itself implies the health problem presented. For example, the procedure “amalgam restoration #2 MOD” suggests the existence and extent of dental caries. If a physician were to chart in that fashion, the documentation would be considered inadequate. For example, the procedure “plaster cast left lower extremity” does not provide information about the original problem. Many dentists in this project felt that documenting a dental diagnosis was redundant and resisted this part of the documentation process.

These last two differences (in treatment plan documentation and the relation of procedure to problem) were not addressed in the initial phases of this clinical automation project. They will provide the basis for the determination of requirements for future releases and components of the project.

**Completing Implementation**

As the project continues, training and implementation assistance will foster a continuing sense of end-user ownership in the automated notewriter and ensure that this new tool becomes integral to patient care. In addition, findings from the training and template revisions identified during initial use will lead to further refinement of the application and the templates for dentistry, and help identify future requirements for software enhancements.
References


About the Authors

Patricia S. Button, EdD, RN, is vice president of Oceania’s government division.

Karen Doyle, RN, MSN, is program manager with the government division and manages this project.

J. William Karitis, DMD, MA, MPH, is a Commander with the United States Navy, Defense Dental Standard Application.

Charles Selhorst, RN, BS, is a clinical consultant with Oceania and lead author of the company’s dental clinical knowledge base.