SECTION ON COMPUTERS AND OTHER TECHNOLOGIES

SUNDAY, OCTOBER 10

2:00 pm–5:00 pm
Franklin Square, The Grand Hyatt
Washington, DC

1:00 pm Welcome
S. Andrew Spooner, MD, FAAP Chairman, Scientific Committee

1) 2:00 pm Clictate: A Structured Reporting Tool for Guideline-based Care
Kevin B. Johnson, MD, MS, FAAP, Aletha Akers, Janet R. Servint MD. Division of Pediatrics, The Johns Hopkins University School of Medicine, Baltimore, MD.

2) 2:20 pm Computerized Voice Recognition as a Replacement for Medical Transcription
Stephen M. Borowitz, MD. Department of Pediatrics, University of Virginia, Charlottesville, VA.

3) 2:40 pm Instant Pocket Wireless Telemedicine Consultations
Loren G. Yamamoto, MD, MPH, MBA, FAAP. Department of Pediatrics, University of Hawaii John A. Burns School of Medicine, Honolulu, HI.

4) 3:00 pm WWW-based Applications for the Neonatal Intensive Care Unit
Charles Hu and Ray Duncan, MD, FAAP. Medical College of Wisconsin, Madison, WI, and Cedars-Sinai Medical Center, Los Angeles, CA.

5) 3:20 pm Introducing a Bedside Terminal System in the NICU: Assessment of User Satisfaction
Richard J. Powers, MD, FAAP, and Jeanette Asselin, RRT, MS. Children's Hospital Oakland, Oakland, CA.

3:40–4:00 pm Coffee Break

6) 4:00 pm Information Seeking Behaviors Among Pediatric Residents
Jay D. Eisenberg, MD. Pediatric Pulmonary Division, Dept. of Pediatrics, Oregon Health Sciences University, Portland, OR. (Sponsored by Dana AV Branner, MD)

7) 4:20 pm Handheld Computers in Residency Training: Development of a Mobile Medical Records System
Jerome K. Wang, M.D. and Ray Duncan, MD, FAAP. Departments of Internal Medicine, Pediatrics, and Enterprise Information Services, Cedars-Sinai Medical Center, Los Angeles, CA.

8) 4:40 pm A New Natural Language Processing Tool for Case Simulations
Christoph U. Lehmann, MD, CFAAP, Bach Nguyen, George R. Kim, MD, FAAP, Kevin B. Johnson, MD, MS, FAAP, and Harold P. Lehmann, MD, PhD, FAAP. Department of Pediatrics, Johns Hopkins University, Baltimore, MD.

5:00 pm Adjourn

ABSTRACTS

1

CLICTATE: A STRUCTURED REPORTING TOOL FOR GUIDELINE-BASED CARE

Kevin B. Johnson, MD, MS, FAAP, Aletha Akers, Janet R. Servint MD. Division of Pediatrics, The Johns Hopkins University School of Medicine, Baltimore, MD.

Background: The recent emphasis on the critical need for computer-based patient records includes an assumption that clinicians will use these systems to document patient care during the patient encounter. In most ambulatory and inpatient settings, this goal has not yet been realized. In conjunction with developing a computer-based patient record (CPR) for our academic medical center, we surveyed our residents about their preferred approach for entering data into the computer. They recognized a need for efficient, flexible documentation tools that used point-and-click data entry wherever possible. In response to their interest and our desire for on-line encounter summaries, we developed a structured reporting environment. This report describes the features of that system, and an evaluation of how it has been used to date.

Methods: Over a 1 year period, focus groups of residents and primary care preceptors met to identify the goals of the program and the contents of the health-maintenance templates. During that time, the first version of the program, Clictate, was created and tested. At the end of the year, 3 versions of the program had been created. After approval was obtained from our clinical and medical record leadership, the program was implemented in a pediatric continuity clinic. We then allowed the program to be used for 1 year, after which the templates were revised, and additional enhancements were made to the program. Residents then were enrolled in a large study evaluating how Clictate was used and to what extent it had an impact on patient-physician interaction. As a part of this study, residents were asked to complete a survey describing how they used Clictate at the conclusion of a subset of their encounters. The subset included one visit from each patient under the age of 18 months that came to the clinic for “well-child care” during the study period.

Results: There were 240 patient enrolled in the study. Residents returned 229, or 95% of the surveys. The enrolled visits were uniformly distributed across all ages (through 15 months) at which health-maintenance visits occur. Using a 5 point Likert scale, 75% of the residents found the developmental milestones section to be “a great deal of help (5)” or “some help (4),” and 73% of the residents rated the anticipatory guidance section similarly. Other sections that received a 4 or 5 were the physical exam (51%) and overall assessment (42.8%) sections. Of those 4 sections, the anticipatory guidance section required typing in addition to mouse selection in almost all cases. The section for social history, a section that required almost exclusively typewritten data entry, received the lowest score for usefulness, with 46.5% of the residents stating that it was either of “no help at all” or “didn't use section.” When asked when in the course of the day they completed each section of documentation, more than 43% of the residents used the computer during the visit for the interim and social history, and more than 54% used it for anticipatory guidance and developmental assessment. However, over 74% of the residents documented physical exam, assessment and plans before seeing the next patient, or sometime thereafter, with most residents completing this documentation “at the end of the clinic session.” Resident use of Clictate during the clinic session was correlated with the degree of help they thought the template provided (R=0.57; P<0.01).

Conclusion: Residents find many aspects of a guideline-based structured reporting tool to be of value. The perceived value may be related to the extent to which typing can be minimized and may
influence or be related to the timing of their documentation. Further research is needed to improve the ease with which all documentation can be completed by the end of a patient encounter.

2

COMPUTERIZED VOICE RECOGNITION AS A REPLACEMENT FOR MEDICAL TRANSCRIPTION

Stephen M. Borowitz, M.D., Department of Pediatrics, University of Virginia, Charlottesville, Virginia 22908

Background: Dictation with transcription is widely used to improve the completeness and legibility of patient records and assure compliance with federal documentation requirements. Transcription costs are $0.17-$0.25 per line and may amount to 11% of collected fees for outpatient visits. Computerized voice recognition is a means of decreasing the cost and improving the turnaround of transcribed documents. Little research has been conducted examining the utility of computerized speech recognition in medical practice.

Methods: The author kept track of the time spent dictating and editing outpatient notes with a stopwatch and log book. Dictations were randomly assigned to human or computer transcription. Computer transcription was performed by either IBM ViaVoice software or Dragon Naturally Speaking software on a Dell 266 mHz Pentium computer with an AWE64 sound card. Data collected included (1) date of visit, (2) date of dictation, (3) time spent dictating, (4) time spent editing, (5) date the final note was completed and filed, (6) length of the final note, and (7) type of visit (initial consultation or follow-up visit).

<table>
<thead>
<tr>
<th>Human</th>
<th>Dragon Naturally Speaking</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of dictations</td>
<td>420</td>
<td>162</td>
</tr>
<tr>
<td>Initial/follow-up visits</td>
<td>156/264</td>
<td>54/106</td>
</tr>
<tr>
<td>Dictation time (sec)</td>
<td>179.88 ± 62.83</td>
<td>197.66 ± 74.22</td>
</tr>
<tr>
<td>Editing time (sec)</td>
<td>148.95 ± 74.08</td>
<td>225.15 ± 95.64</td>
</tr>
<tr>
<td>Total dictating and editing time (sec)</td>
<td>328.82 ± 130.05</td>
<td>422.81 ± 160.45</td>
</tr>
<tr>
<td>Completion time (days)</td>
<td>5.94 ± 1.80</td>
<td>0.28 ± 0.50</td>
</tr>
<tr>
<td>Length of final note</td>
<td>50.01 ± 16.61</td>
<td>50.78 ± 17.75</td>
</tr>
</tbody>
</table>

Results: Data are summarized in the table. During the study period, the author dictated 792 notes. 420 were completed by a transcriptionist, 210 by ViaVoice, and 162 by Naturally Speaking. The proportion of initial and follow-up visits transcribed by the three systems was comparable. The time spent dictating with Naturally Speaking was significantly greater than with either human transcription or ViaVoice. The amount of time spent editing was substantially greater using both ViaVoice and Naturally Speaking than using human transcription. Notes generated by ViaVoice were shorter than notes generated with human transcription or Naturally Speaking however there was no difference in the length of notes generated by Naturally Speaking and human transcription. The time to the completion of notes was significantly shorter using both ViaVoice and Naturally Speaking than using a human transcriptionist.

Conclusions: Currently available computerized dictation systems are practical and fast enough to replace human transcription. The time spent dictating and editing notes with computerized voice recognition is approximately 25% greater than if the notes are transcribed by a medical transcriptionist however notes are completed substantially faster when generated by computer as compared to a human transcriptionist. With continuing technological improvements, the incentives to use computerized voice recognition systems in medical practice will far outweigh any of its drawbacks.

3

INSTANT POCKET WIRELESS TELEMEDICINE CONSULTATIONS

Loren G. Yamamoto, MD, MPH, MBA, FAAP Emergency Services, Kapiolani Medical Center For Women And Children Department of Pediatrics, University of Hawaii John A. Burns School of Medicine Honolulu, Hawaii

Background: Consultation with specialists such as neurosurgeons may not be immediately available in many non-tertiary care settings. Stat neurosurgical consultation is often necessary in the acutely head injured child to facilitate transfer and to prepare an operative team at the tertiary center. Most clinical information can be given to the neurosurgeon over the phone, but the patient's CT scan is best viewed by the neurosurgeon rather than described verbally. Teleradiology can transmit the patient's CT scan to a receiving teleradiology unit, but the neurosurgeon must travel to the teleradiology unit to view the image. The availability of wallet sized pocket computers and wireless modem card devices can provide a neurosurgeon with pocket teleradiology capability. In addition to cellular telephone networks, many new wireless digital networks are currently available to provide wireless connectivity for many different purposes. The purpose of this study is to demonstrate the feasibility of wireless telemedicine links for instant access to consultants anywhere they may be.

Methods: A pocket computer (available at $699) with a 640 by 240 pixel screen installed with a wireless digital modem using the CDPD (cellular digital packet data) wireless data network was used to access CT scan images from a web server on the internet at 19,200 baud. This computer unit measures 19.7 cm by 12.7 cm by 3.2 cm (162 grams). No special software was installed on the pocket computer. No connection to a separate phone unit was required. Five sets of test CT scan images (each set consisted of 1, 3, or 4 CT cuts totalling 11 CT cuts) were uploaded into a web server for download testing into the pocket computer.

Results: These five sets of CT scan images, totalling 188.7 Kbytes in JPEG (averaging 17 Kbytes per CT cut), were accessed wirelessly and viewed using the pocket computer’s built in web browser without problems. No wire connections, additional software or special computer commands were required to view the images. Viewing times from turning the unit on to seeing the images took 5 minutes (the first 50 seconds were required to log on to the world wide web) for an average download speed of 755 bytes per second (7,550 baud), short of the theoretical maximum of 19,200 baud. This was done locally within the same city, but it could just as easily have occurred 2000 miles away or more.

Conclusion: Pocket computers with wireless internet access have powerful multimedia and telecommunication capabilities permitting teleradiology functions in a pocket device. These units are convenient, portable and inexpensive. They facilitate the further growth and development of telemedicine by eliminating the need to travel to teleradiology centers or to access a PC for connection to a network.

Special thanks to GTE Wireless for providing hardware and wireless network access to make this study possible.
WWW-BASED APPLICATIONS FOR THE NEONATAL INTENSIVE CARE UNIT

Charles Hu and Ray Duncan, M.D., Medical College of Wisconsin, Madison, Wisconsin, and Departments of Pediatrics and Enterprise Information Services, Cedars-Sinai Medical Center, Los Angeles, California.

Background: Computerized decision-support applications can simplify the process of ordering drugs and solutions in the Neonatal Intensive Care Unit (NICU) and reduce the incidence of calculation errors. The World Wide Web (WWW) has made it possible to rapidly build and deploy such applications in a platform-independent manner.

Methods: Parallel versions of several WWW-based applications for the NICU were developed in both client-side JavaScript and server-side Microsoft Active Server Pages (ASP) to test performance and portability on a variety of WWW browsers. Certain of the applications were previously implemented in Microsoft Basic, VAX RDB, Apple HyperCard, or Symantec ThinK. Information is collected from the clinician via Hyper Text Markup Language (HTML) "forms" displayed in a WWW browser.

Calculations are carried out on the client (JavaScript versions) or on the server (ASP versions), using information stored on the server. The results are delivered to the user via the browser. Graphs and charts are created dynamically and embedded in WWW pages using ServerObjects' ASPChart, an ActiveX module that can be called from an ASP application to generate JPEG images.

Results: The four WWW-based patient-care applications listed below are now in routine use in the CSMC NICU:

1. Quick IV: The physician supplies the patient's weight and the desired amount of fluids, dextrose, sodium, potassium, calcium, and heparin per unit weight per day. The application calculates the exact amounts of fluids, dextrose, electrolytes, and heparin to mix in the IV solution, along with the delivery rate.

2. Quick Drip: The physician selects a constant infusion medication from a list and supplies the patient's weight, the desired volume per hour, and the desired dose-per-weight-per-unit time. The application checks the dosage against built-in limits and calculates the amount of drug to be mixed in a standard volume.

3. Code Sheet: The physician supplies the patient's name, weight, and birth-date. The application calculates patient-specific dosages for drugs used during a neonatal resuscitation, and generates a "Code Sheet" that can be printed and posted at the bedside for ready reference during an emergency.

4. Growth Chart: The application generates three different charts of weight and head circumference for the period from 24 weeks gestation to term plus three-months, based on curves published in the pediatric literature, and plots the patient's weights on the curves.

Conclusion: The explosion of the Internet and the WWW, and the proliferation of low-cost, powerful, easy-to-use development tools for WWW servers and applications, have made it easy to build user-friendly, graphically-enabled, platform-independent decision support applications for physicians and nurses working in the NICU. These applications can be accessed from clinical workstations throughout the patient care areas, as well as the desktop computers in the physician and nurse offices.

INTRODUCING A BEDSIDE TERMINAL SYSTEM IN THE NICU—ASSESSMENT OF USER SATISFACTION

Richard J. Powers, M.D., FAAP and Jeanette Asselin, RRT, MS, Children's Hospital Oakland, Oakland, CA.

Background: We recently introduced an electronic charting system into an area of our NICU, as phase I of a proposed unit-wide installation. To evaluate the system, and compare it with our conventional paper charting system, we administered a customer satisfaction survey to the users of the system at the end of the first phase.

Methods: The Hewlett Packard CareVue 9000 system was installed in the most acute 8 bed room of a 52 bed tertiary referral NICU. All NICU nurses and respiratory therapists were given 4 hours of classroom training with the system; other users received on the job training after "go-live." After the "go-live" date, no paper records were used in this room. After a 15-month trial period, satisfaction was surveyed among all users of the system, using a custom survey tool.

Results: Overall response rate to the survey was 166/285 (58%). One hundred thirty-four questionnaires were included in this analysis. The breakdown of respondents was 99 nurses, 27 physicians and 9 "others." Overall satisfaction with the electronic charting system compared with the conventional paper system was 48% satisfied vs. 52% not satisfied or undecided. Six variables were analyzed for their correlation with overall satisfaction: use of a PC at home; greater than 10 years experience in the NICU; professional discipline, M.D. vs. RN or Respiratory Therapist; frequency of use, < lx/wk vs. ≥ lx/wk; and whether the system was used for retrieval of data or for other tasks, including documentation, care planning or combinations of these. Multivariate correlation analysis showed the only significant factors influencing satisfaction were frequency of use ≥ lx/wk (p<.01); and use of the system for retrieval of data alone as compared to documentation or multiple tasks (p<.01).

Conclusion: Overall user satisfaction was 48% when compared to paper flowsheets. This reflects the difficulty in introducing electronic charting into a busy NICU setting with high acuity. Two contributing factors were significant in the acceptance of this technology: frequency of use and complexity of the tasks required of the user. Acceptance of any new charting system can be difficult. Better acceptance of electronic charting in the NICU setting may be achieved by introducing it in less acute areas, encouraging a broader utilization, and insuring all users are exposed to it on a regular basis.

INFORMATION SEEKING BEHAVIORS AMONG PEDIATRIC RESIDENTS

Jay D. Eisenberg, MD, Pediatric Pulmonary Division, Dept. of Pediatrics, Oregon Health Sciences University (OHSU), Portland, OR. (Sponsored by Dana A.V. Brainer, MD)

Background: Teaching information management skills is important at all levels of medical education as information technologies become more accessible and sophisticated. Evaluation of information seeking strategies can help assess how to teach information management skills. The purpose of this study was to assess the types of information resources used by pediatric residents. Methods: Three clinical scenarios where the resident might want to obtain more information before proceeding with a diagnostic workup or therapy were presented to participating residents. Residents articulated questions they wanted answered, and were asked which resource they would use to pursue the answer. Questions asked were categorized as diagnosis, therapy, or general question. Information resources were textbooks, reference texts, journal articles, MEDLINE, World Wide Web (WWW), or a
colleague. Differences and associations among training levels, scenarios, and types of questions associated with each information resource were examined. Results: Seventeen residents generated 116 questions: 42% were about diagnosis, 30% about therapy, and 28% were general questions. Information resources used to pursue the questions were: MEDLINE 40%, textbook 29%, reference texts 11%, WWW 10%, human 6%, and journal articles 4%. 44% of questions asked by first year residents (PL1) were about diagnosis compared to 28% of questions asked by second year (PL2) and 27% of questions asked by third year (PL3) residents. These differences were not significant (p>.05). Different information resources were used by residents at different training levels, with 44% of PL1 residents using textbooks as their most common resource, while PL2 and PL3 residents primarily used MEDLINE (53% and 40%, respectively) (p<.005). MEDLINE was the most common resource for questions about therapy and general disease topics. Textbooks were the most common resource for questions about diagnosis. There was a significant association between type of question and information resource used (p<.001). Residents felt that textbooks lagged behind the primary literature but were useful for guidelines for diagnosis. They preferred review articles to primary research articles. Some residents were not sure if MEDLINE provided the type of resource they wanted (e.g., NIH management guidelines). Most residents knew about WWW search engines but did not know advanced searching techniques. Evidence-based medicine resources were not familiar to most of the residents. Conclusion: With more experience, residents ask more questions about therapy and fewer questions about diagnosis. Information management skills should include advanced bibliographic database and WWW searching, and accessing and evaluating evidence-based medicine resources. Textbooks are a common information resource and their use should not be de-emphasized. Further assessments of information seeking behaviors utilizing multiple techniques in multiple settings should be performed as medical informatics curricula are developed.

7

HANDHELD COMPUTERS IN RESIDENCY TRAINING: DEVELOPMENT OF A MOBILE MEDICAL RECORDS SYSTEM

Jerome K. Wang, M.D. and Ray Duncan, M.D., Departments of Internal Medicine, Pediatrics, and Enterprise Information Services, Cedars-Sinai Medical Center, Los Angeles, California.

Background: The use of mobile computing devices among physicians has become increasingly widespread. In our medical center, many physicians-in-training rely on portable computers for organization of daily tasks, electronic mail, quick access to key medical information, and personal or work-related notes. A wide variety of pocket-sized computing devices are available, each with distinct advantages and limitations. We describe the development of a prototypic mobile database that allows its users to more efficiently document, communicate, and access important patient information. In the future, this concept may play a role in the transition between a paper-based and electronic medical record in our health system.

Methods: After assessing the currently available devices and development tools, we chose to base our application on the Windows CE operating system (Microsoft Corp.). The graphical user-interface and the underlying database tables for the mobile device were implemented using Visual CE (Syware, Inc.), a Windows CE development tool that runs on the Windows 98 platform. The completed application was then downloaded to a handheld Windows CE device for mobile use and was piloted in the Medicine-Pediatrics house-staff continuity clinic for electronic documentation of patient encounters. The information residing on the mobile computer was synchronized on a regular basis with a Microsoft Access 97 database on a desktop PC. The printed reports were generated from the Access database, including complete documentation of the patient encounter, prescriptions, and problem lists. Furthermore, the mobile database information was reorganized into a more efficient relational database structure in Microsoft Access, in anticipation of eventual uploads into a hospital-wide clinical data repository.

Results: The pilot use of a mobile device database application in the combined Internal Medicine-Pediatric ambulatory clinic in our hospital has resulted in subjective improvements in the quality, readability, and turn-around time for medical documentation. House-staff appreciate the ability to have key patient information immediately available without recourse to the printed chart and to share this information among members of the patient care team. Objective measurements of impact on ease of access to patient information, physician communication, and patient satisfaction are still being collected.

Conclusion: The use of a mobile database application in the ambulatory clinic allows the collection and retrieval of patient information at the point-of-care with greater efficiency, minimizing repetitious data entry and enhancing documentation. In addition, it enables synchronization of the patient information with a desktop- or server-based database, and may prove to be an important step in the transition toward a full-fledged computer-based medical record.

8

A NEW NATURAL LANGUAGE PROCESSING TOOL FOR CASE SIMULATIONS

Christoph U. Lehmann, MD, CFAAP, Bach Nguyen, George R. Kim, MD, FAAP, Kevin B. Johnson, MD, FAAP, and Harold P. Lehmann, MD, PhD, FAAP, Dept of Peds, Johns Hopkins University, Baltimore, MD.

Background: Computer-based case simulations of patient encounters, using varying degrees of verisimilitude, have been recognized as a popular and beneficial format for medical education including CME. Case simulations enable learners to acquire evaluation and management skills and become familiar with current developments in medicine in an efficient and reproducible manner without having to expose real patients to the learner. To develop good history-taking skills, the trainee must learn to elicit responses from patients in a logical, thorough, and sensitive fashion. Unlike programmer prepared history menus, Natural Language Processing (NLP) forces the learner to formulate the appropriate options on their own and provides a higher degree of realism and an improved learning experience.

Methods: The Interactive Patient II (under construction at http://omie.meb.jhmi.edu/IP2) is a multimedia, Web-based, clinical simulation designed to teach medical trainees history-taking and physical examination skills. We developed a natural language parser called General Recognition and Analysis of Sentences and Phrases (GRASP) to allow users to inquire about history-related knowledge appropriate for a physician-patient relationship. The core process of GRASP is to return a Canonical Phrase and the related case finding in response to any user query. This is accomplished in two steps: First, word-level synonyms are identified and Canonical Terms are returned. Second, sorted Canonical Term combinations are used to determine the correct Canonical Phrase. By allowing phrases to be linked to multiple Canonical Terms, GRASP allows for the recognition of ambiguous words. Using Canonical Term combinations, GRASP is able to identify the correct Canonical Phrase and implicitly determine the appropriate word sense for the ambiguous phrase.

Results: To evaluate GRASP, fifty random findings from the knowledge database were chosen and questions/queries formulated that a user might use to access these findings through GRASP. All queries were entered into GRASP and in 48 cases (96%), GRASP returned a Canonical Phrase that correlated to the desired finding. In one case, a misspelled phrase in the Phrase list resulted in a mismatch, while in the other case, a related Canonical...
Phrase was returned which had a higher priority in the sorting of Canonical Term combinations. While the resulting Canonical Phrase was not an exact match, the concept returned was similar enough to result in a meaningful answer to a user's query. Six sample questions containing two ambiguous words ("arms", "drugs") were used. In each case, GRASP was able to identify the appropriate Canonical Phrase. The delay between a query and the return of a Canonical Phrase and the related finding in the knowledge database varied significantly. Detailed and specific queries (i.e. "Does your chest pain radiate into your arm?") resulted in significantly faster (less than 2 seconds) responses than broader and more generalized queries (i.e. "Do you have pain?") (3–5 seconds).

Conclusion: We created a natural language interface for case simulations that has the ability to handle ambiguous word senses and to match user questions/queries to unique Canonical Phrases and patient findings in our knowledge database. GRASP allows learners to interact with a case simulation at a higher level of verisimilitude resulting in an improved learning experience.

This work was funded in part by the National Library of Medicine (Grant # F38LM00064) and by the National Board of Medical Examiners (Project # 34-9798).
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