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The Steering Committee on Clinical Information Technology

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Steering Committee on Clinical Information Technology Scientific Abstract Presentations

Sunday, October 10, 2004

Oral Presentations

2:00 pm

A Computerized Program to Determine Standardized Drug Concentrations for Continuous Medication Infusions.

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Purpose: Continuous infusions of medications such as vasoactive drugs (eg, Dopamine) are often used in critically ill infants and children. A recent mandate by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requires all pediatric hospitals to limit and standardize the concentrations of such infusions. Prior to this mandate, the "rule of six" method used to determine drug concentrations resulted in a unique concentration for each patient. Limiting the concentrations poses a significant challenge, given the wide range of weights and fluid requirements in pediatric patients. A computerized program, the "Concentration Optimizer," was developed to automate this process.

Methods: The program included forty commonly used infusions and accepted user-input for the following parameters for each drug; (i) minimum and maximum dose, (ii) dose increment interval, (iii) lowest patient weight in whom the drug would be used, (iv) lowest acceptable pump infusion rate (mL/hour), and (v) maximum acceptable fluid load resulting from the infusion. A computerized algorithm was developed that generated two to four concentrations, which resulted in an acceptable fluid load for all weight and dose ranges. For each concentration, a table displayed infusion rates at different weight and dose ranges. For a given weight and dose, the program recommended one optimum concentration.

Results: For each of the forty drugs, the "Concentration Optimizer" dynamically generated two to four ideal concentrations, as well as an infusion rate table as soon as user input was complete. Concentrations suggested by the program were within the maximum acceptable fluid limit set by the user across a wide range of weights (0.5 to 70 kg) and doses.

Conclusion: The program was successful in automating the process of rapidly identifying ideal concentrations that met the needs of diverse weight and dose ranges. Use of the program in a collaborative manner by multiple institutions may help develop a national consensus for standard concentrations. Pharmaceutical companies may start to manufacture these standard concentrations, leading to an additional level of patient safety.

2:15 pm

Evaluating a Diabetes Predition Tool With Continuous Glucose Monitoring.

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Purpose: Diabetes self-management involves a difficult balancing act between insulin, food and exercise, largely relying on "trial and error." The challenge is to develop innovative, validated prediction tools to empower patients to make appropriate adjustments to optimise glycaemic control. "Librae" is a computerised diabetes simulator tool in diary format and has been developed as a predictive tool for patients, reducing the "trial and error" approach by allowing them to simulate and experiment with dietary or insulin

(Note: Underlining denotes presenting author.)

Table 1. High Importance Steps (Kim, et al)

	Correct Order Format (Treatment Plan)	Correct Order Format (Order)	Order & Treatment Plan match	Cumulative Dose on Treatment Plan	Correct Calculation	RN Check List present
Paper	**96%**	**97.9%**	**98.9%**	**82.1%**	**94.2%**	**95.2%**
Computer	**97.4%**	**99.4%**	**94%**	**94.3%**	**99.5%**	**97.6%**
	***P* < 0.05**	***P* < 0.01**	***P* < 0.001**	***P* < 0.001**	***P* < 0.001**	***P* < 0.01**

adjustments on a "body-double." We have evaluated the predictive ability of "Librae" using a Medtronic™ Continuous Glucose Monitoring System (CGMS).

Methods: Patients with Type 1 Diabetes were invited to use "Librae" for one week and were then fitted with a CGMS for 72 hours. The predictive ability of "Librae" was then compared with concurrent data obtained from the CGMS over the 72-hour period. 11 patients piloted "Librae," mean age 14.8 years (range 7.48–21.1) with average duration of diagnosis 3.3 years (range 0.1–7.7) on a variety of insulin regimens (2 twice-daily pre-mixed insulin, 5 basal-bolus and 4 pump therapy) with a mean HbA1c of 8.3% (range 6.4–11.8).

Results: 7960 paired glucose readings were obtained from the 11 patients. "Librae" exhibited a slight underestimation of the measured CGMS values, the error having a positive mean of 0.35 mmol/L (95% confidence interval 0.22-0.48 mmol/L). However, a scatter graph of error against CGMS reveals that "Librae" tends to under-estimate at high measured glucose values and over-estimate at low measured glucose values.

Conclusion: The "Librae" data correlated well with the CGMS data overall. This validation study provides a large data set to further improve the mathematical model. "Librae" may provide a tool to empower patients to make appropriate adjustments to their diabetes routine and optimise their glycaemic control.

2:30 pm

Safety in Pediatric Oncology: Provider Order Entry.

George R. Kim, MD,[1] Allen R. Chen, MD,[2] Robert J. Arceci, MD, PhD,[2] K. Michelle Kokoszka, RN,[2] Denise Daniel, RN,[2] Christoph U. Lehmann, MD.[1]
[1]Division of Health Sciences Informatics, Johns Hopkins University School of Medicine, Baltimore, MD; [2]Division of Pediatric Oncology, Johns Hopkins University School of Medicine, Baltimore, MD.

Purpose: Medication safety in pediatric oncology is a significant challenge. Inherent complexities in scheduling, administration and tracking of agents, intrinsic toxicity, low therapeutic indices, and variable dosing requirements of children, may result in acute and cumulative morbidity and mortality. To decrease chemotherapy errors in pediatric oncology in an academic medical center, a computerized order entry system was implemented and its impact on errors assessed.

Methods: Modifying an available pharmacy system, a computerized order entry system for pediatric oncology was designed. System features include forced data entry for height, weight and protocol, menu-driven order selection, automated single and cumulative dosage calculation with required justification of dose changes and a printed paper order. Data was collected over two epochs: the first over a year (8/01-8/02), before, and the second over 9 months (5/03-2/04), after system incorporation into workflow. Specific steps in the process, as captured by the tracking systems were designated as "high-importance" by a domain expert (ARC) by their potential for high morbidity and mortality.

Results: Over the two epochs, data for 2518 and 1116 encounters respectively was captured. Rates for completion of "high-importance" steps were improved significantly for listing of cumulative doses, calculation, nursing check list and proper order format. (See Table 1.) Orders however were less likely to match the treatment plan.

Conclusion: Using computerized order entry significantly improved most high-importance steps. However, since our system did not include treatment plans, there was an increase in discrepancy between treatment plans and orders. Future developments will focus on order sets and incorporation of treatment plans.

2:45 pm

Comparison of a Computerized Program for Management of Pediatric Diabetic Ketoacidosis to a Conventional Paper-Based Clinical Pathway.

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Purpose: Objective: To determine if a computerized program for initial management of diabetic ketoacidosis (DKA) in children is faster and more accurate than a paper-based pathway using simulated case scenarios.
Design: Prospective, randomized, controlled study
Setting: A tertiary, urban, teaching university hospital

Methods: A computerized program was developed for management of pediatric DKA patients using guidelines from an existing paper-based pathway. The subjects were 29 pediatric residents. The volunteers were randomized to use either the computerized program or paper-based pathway using block randomization within each year of residency training. Groups did not crossover.

Table 2: Error Distribution (Gujral, et al)

	Number of orders	Orders with errors	Physician contacted	Severe errors
Hand	**149**	**49 (33%)**	**35 (23%)**	**55 (37%)**
Calculator	**142**	**8 (6%)***	**4 (3%)***	**0 (0%)***
Total	**291**	**57 (20%)**	**39 (13%)**	**55 (19%)**

*$P < 0.001$.

Each subject was given two different written case scenarios and was then asked to generate rehydration fluid and insulin orders. The paper-based group (PBG) had access to the university-accepted clinical pathway, a calculator, and a body surface area nomogram. The computerized group (CG) had access to the computerized program. The main outcome measures were: 1) time to order completion and 2) the clinical accuracy of the orders. User satisfaction in the CG was determined by a post-study survey. The two groups were statistically compared using a two-tailed Student's t-test.

Results: Of the 29 volunteer subjects, 18 (62%) randomized to the CG and 11 (38%) to the PBG. The CG required a mean of 81 seconds [1 minute, 21 seconds] to generate DKA orders versus 635 seconds [10 minutes, 35 seconds] for the PBG ($P < 0.0001$). In the CG, 100% of the DKA orders were correct, while in the PBG, only 65.5% of the orders were correct ($P < 0.0001$). Of the 18 subjects in the CG, 15 previously used the paper-baed pathway to clinicaly manage DKA patients during their residency training. In the survey, all 15 subjects in this sub-group indicated their preference for the computerized pathway.

Conclusion: The use of a computerized DKA management program in a clinically simulated setting was faster and more accurate than the traditional paper-based pathway. In addition, user satisfaction and acceptance of the computerized program was very high with unanimous preference for the computerized program.

3:00 pm
Reducing Physician Errors: Web-Based Infusion Medication Calculator.

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[1]Division of Pediatric Pharmacy, Johns Hopkins Hospital, Baltimore, MD; [2]Department of Pediatrics, Johns Hopkins University, Baltimore, MD.

Purpose: Weight-based dosing makes the ordering of infusion medications a difficult and error prone task. We evaluated the impact of a web-based infusion calculator on provider errors in a pediatric hospital.

Methods: The calculator was developed using Microsoft Access™ and Allaire Cold Fusion™. It performs all calculations based on physicians' input via Internet browser. It determines the infusion concentration based on dose, weight and flow rate. With ready-to-use concentrations, the calculator determines the flow rate. It guides the user with default dosing and contains maximum concentration and dose guidelines. It alerts the user of inappropriate carrier fluids and drips that will run out prematurely. Residents were encouraged (not mandated) to use the calculator. Data was collected on all infusion orders and associated physician errors detected by the pharmacist before and after the calculator became available (2-month periods).

Results: Prior to the calculator, all 129 orders (100%) were done by hand. After introduction, 142 out of 162 orders (88%) were done with the calculator. Comparing hand written orders to calculator generated orders showed 83% reduction ($P < 0.001$) in the number of orders with at least one error. (Table 2)

A total of 91 errors were recorded (82 in the hand ordered group). If a physician ordered an infusion by hand, he/she was significantly more likely to generate at least one error, generate severe errors such as decimal errors, incorrect doses or incorrect unit of measure and receive a phone call from pharmacy. There were no severe errors found if the order was calculator generated. All errors in the calculator group were omissions such as missing patient identifier or physician signature.

Conclusion: The introduction of a web-based infusion calculator significantly reduced detectable physician errors. After reviewing the data contained in this abstract, the use of the calculator was made mandatory.

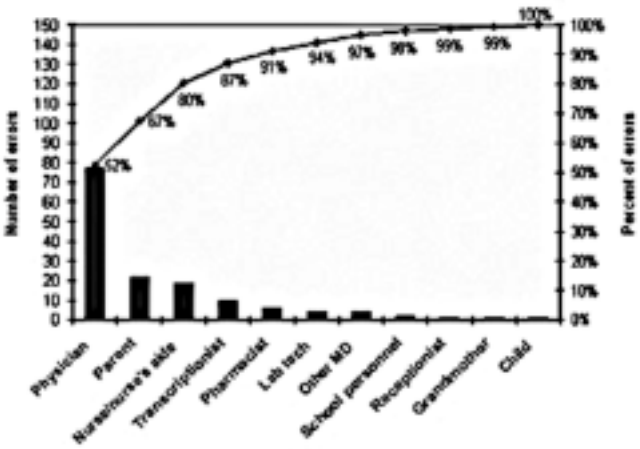
3:30 pm
Learning From Errors in Ambulatory Pediatrics (LEAP).

Julie J. Mohr, MSPH, PhD,[1] Carole Lannon, MD, MPH,[2] Kathy Thoma, MS,[3] Donna Woods, PhD,[4] Eric Slora, PhD,[3] Mort Wasserman, MD,[3] Lynne Uhring, MD.[3]
[1]Department of Medicine, University of Chicago, Chicago, IL; [2]Pediatrics, University of North Carolina, Chapel Hill, NC; [3]Pedatric Research in Office Settings (PROS) Network, American Academy of Pediatrics; [4]Northwestern University, Chicago, IL.

Purpose: Approximately 70% of pediatric care occurs in ambulatory settings, yet we face a significant lack of published research on the nature, frequency, and causes of errors and harm in pediatric ambulatory care. LEAP – Learning from Errors in Ambulatory Pediatrics – was designed to (1) develop a secure, web-based tool for reporting errors and (2) identify types and range of errors that are occurring in children's ambulatory care.

Methods: Data collection was piloted in 5 pediatric practices in April 2003. 14 sites participated in data collection from June - Sept. 2003. 3 members of the research team (1 pediatrician and 2 patient safety researchers) independently coded the qualitative error reports using the constant comparative method. Discrepancies in the coding were reconciled by research team consensus.

Figure 1. Who Discovered the Error?



Results: 147 mutually exclusive errors were reported. Administrative (22%) and Medical Treatment (38%) errors were most frequent. Physicians reported errors, yet various members of the care team (see Fig 1) discovered the errors. These results suggest that everyone has a role preventing errors from reaching the child.

Conclusion: Data collection via the web-based tool was very successful; practitioners reported a high degree of satisfaction and a minimal number of problems. The prospective nature of this study allowed us to detect errors that did not result in harm to the patient—these types of errors would be difficult to identify in a retrospective chart review. Information learned from this study will be instrumental to the subsequent design of interventions to improve patient safety for children.

3:45 pm

Automated Surveillance of Pneumonia in Neonates Using Natural Language Processing of Radiology Reports.

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Purpose: Surveillance of infectious disease is critical for health care but manual methods are costly, inconsistent, and error prone. An automated system using NLP would be an invaluable tool that could be used to improve surveillance, including nosocomial infections, emerging infectious diseases and biothreats.

Methods: A two-year crossover study was conducted independently of this NLP effort in two neonatal intensive care units (NICUs) to assess the impact of hand hygiene products on rates of nosocomial infection: NICU-A and NICU-B. An infection control practitioner, using the CDC National Nosocomial Infection Surveillance System (NNIS) definitions, performed the surveillance for infections in both units. Cases were reviewed manually and prospectively. The diagnosis of infection was validated with the physician co-investigator from each unit. As part of this study, we evaluated the feasibility of using the NLP system (MedLEE) to automatically identify potential cases of nosocomial pneumonia in neonates. The automated monitoring system consisted of two components: a) the MedLEE NLP system, and b) medical rules that access the output generated by MedLEE.

Results: From the total of 1,688 neonates admitted to NICU-A, 1,277 neonates had 7,928 chest radiographs. Based on the experts evaluation, only 7 neonates had nosocomial pneumonia. Cases were confirmed by cultures. The automated system found the presence of pneumonia in 63 patients, including 5 patients identified by the experts. One of the missed cases was a neonate with cardiac problems with no radiographic findings of pneumonia. The pulmonary biopsy was positive. In the second case, the report presented the finding *increased opacity*, which would trigger the rule, but the word *increased* was misspelled. The finding *opacity* only triggers the rules if the modifier *increased* is also present. The sensitivity of the automated system was 71%, while specificity was 99%. A manual analyzes of the false positive cases was performed.

Conclusion: The results showed that an automated system could be used for automated surveillance. Ongoing work includes refinement of the rules and validation with data from NICU-B.

4:00 pm

Wellcaretracker™—Linking Child Care Centers with Medical Homes—A Technology-Based "Push" Strategy to Improve Immunization and Health Screening Completeness.

Jerold M. Aronson, MD, MPH, FAAP, Stuart T. Weinberg, MD, FAAP. ECELS—Healthy Child Care America, PA Chapter—American Academy of Pediatrics, Media, PA.

Purpose: Public/private sector collaboration is required to attain the USPHS Healthy People 2010 Goal of 95% immunization completeness for all vaccines for children enrolled in child (day) care. Health screening completeness lacks benchmark data. Primary care reliance upon a "Pull Strategy" to increase immunization completeness (eg, compliance with "Standards for Immunization Practices") is not sufficient. Providing early educators in day care programs with computer tools (eg, WellCareTracker™) to track preventive care on enrolled children complements vaccine registry initiatives, and adds a "Push Strategy" to medical homes for vaccine and health screening update.

Methods: Six years of statewide child care preventive care data on a 10% sample of children (>95,000 health records overall; in 2002 = 13,645 children in 3,500 child care programs) and one year of data directly entered by educators on 100% of enrolled children in their child care centers (initiated in 2003) was assessed. Changes in immunization and health screening documentation are measured. Data from the 10% statewide sample will be contrasted with data from the 100% cohort entered by individual centers.

Results: Enrolled children in licensed centers are more completely immunized than similar age children in the general population. While some individual antigen completeness (2002-03) exceeds USPHS 2010 Goals, 4:3:1:3:3:1 completeness is only 74.5% for children ages 19-35 months. Trend data over six years show continual improvement, including varicella, and PCV-7. However, age-appropriate total preventive completeness per AAP Guidelines (vaccines and health screenings) is less than 25%. One years experience with implementation directly in child care programs shows they are interested, willing, and able to use computer tools to track preventive care.

Conclusion: Improving immunization performance for children attending child (day) care is achievable using a combination of public/private "Push-Pull" initiatives. Documenting and improving health screening services is more challenging. As a tracking tool, Web-based WellCareTracker™, optimizes the use of limited resources.

4:15 pm
Evaluation of Two On line Pediatric Diagnosis Systems.

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Purpose: We used published pediatric cases to evaluate the ability of two free, web-based, pediatric diagnostic decision support systems to make the correct diagnosis and generate a useful differential.

Methods: Two physician operators entered findings from the first 10 cases in a published book of pediatric cases into Isabel (http://www.isabel.org.uk) and Dxplain (http://www.merckmedicus.com). Both of these systems have pediatric domains. We measured the rate at which each system made the diagnosis and the extent to which the program listed the items in the textbook's differential diagnosis. We also compared the shorter list of Dxplain's supported diagnoses to Isabel's first tier diagnoses as a way of comparing the two systems' estimates of the most likely diagnostic possibilities.

Results: For operator A (SAS) Dxplain performed similarly at mentioning the correct diagnosis (9/10 vs 6/10, NS). Dxplain also performed similarly at including the correct diagnosis in its most likely diagnoses (8/10 vs 6/10, NS). The average percentage of items from the textbook's differential that each system mentioned for operator A was 54% for Dxplain and 36% for Isabel. Results for operator B (SCR) were similar: mentioning the correct diagnosis at all (Dxplain's 7/10 vs Isabel's 6/10); including the correct diagnosis in the most likely diagnoses (6/10 vs 3/10); and average percentage of textbook's differential (55% vs 28%).

Conclusion: Operator factors related to choice of terms affected results somewhat, but not to a significant degree. Dxplain's process of interviewing the operator made the term selection process more transparent; in contrast, it was unclear how Isabel interpreted some of the terms. Dxplain's performance could have been enhanced if the operators had continued to enter terms according to the system's prompts, but since this feature was not available on Isabel, we did not investigate these results. Online diagnostic systems in pediatrics exist and can be shown to respond with reasonable differential diagnoses. Larger studies are needed to characterize the relative accuracy of these two systems.

4:30 pm
The Standard Sharable Active Guideline Environment.

Robert M. Abarbanel, MD, PhD,[1] Nick Beard, MD, MSc,[1] James R. Campbell, MD,[2] Stanley M. Huff, MD,[3] James G. Mansfield, PhD,[4] Eric Mays, PhD,[1] Mark A. Musen, MD, PhD,[5] Prabhu Ram, PhD,[1] Sidna M. Scheitel, MD,[6] Samson W. Tu, MS.[5]
[1]Health Informatics, IDX Systems Corporation, Seattle, WA; [2]Internal Medicine, University of Nebraska Medical Center, Omaha, NE; [3]Medical Informatics, Intermountain Health Care, Salt Lake City, UT; [4]Apelon, Inc., Ridgefield, CT; [5]Stanford Medical Informatics, Stanford University, Stanford, CA; [6]Primary Care Internal Medicine and Health Care Policy and Research, Mayo Clinic, Rochester, MN.

Purpose: The SAGE Project is a multi-insitiution, multi-disciplinary effort to develop a standards-based informatics infrastructure to enable encoding and dissemination of interoperable, computable clinical practice guidelines. Key deliverables of this project include: An interoperable guideline model, a guideline authoring/encoding workbench, a common set of controlled terminologies and information models, and a guideline deployment system.

Methods: Meeting our objectives required simultaneous, integrated solution of several significant challenges:
a) We have developed a comprehensive, robust guideline knowledge representation model that organizes guideline content as formalized recommendation sets.
b) We address semantic interoperability by incorporating a "virtual medical record."
c) We employ a "workflow aware" approach to interaction between guideline-driven decision support system and the host CIS.
d) We have developed an interoperable SAGE guideline execution technology that interprets encoded guideline content; activates guideline logic in response to appropriate clinical events; retrieves patient data from the medical record; makes patient-specific recommendations based on guideline logic; and surfaces those recommendations via actions of the host CIS.

Results: We have successfully installed, set up, and executed SAGE guideline content at multiple test sites and have demonstrated a feasible infrastructure for encoding evidence-based best practices and wide spread deployment of guideline-driven clinical decision support.

Conclusion: Clinical guidelines can be developed and encoded in a sharable neutral format. Future research needs to be done to determine the impact on clinician behavior and clinical outcomes. We have made clear that this type of guideline system is feasible and that with emerging standards has a good chance to become available across a number of delivery environments. Our standard representation embodies the logic and semantics and evidence for a set of guidelines. Our execution engine serves as an example of how such guidelines can be deployed.

Steering Committee on Clinical Information Technology

Sunday, October 10, 2004

Poster Presentations

4:45-5:30 pm

P1

Utility and Feasibility of Using a Personal Digital Assistants (PDA) Database for ED Patient Follow-up.

Abu NGA Khan, MD, MS,[1,2] Rajesh Geria, MD,[2] Antonios Likourezos, MA, MPH,[2] Giora Winnik, MD,[2] Steven J. Davidson, MD, MBA.[2]

[1]Pediatrics, Morgan Stanley Children Hospital, Columbia College of Physicians and Surgeons, New York, NY; [2]Emergency Medicine, Maimonides Medical Center, Brooklyn, NY.

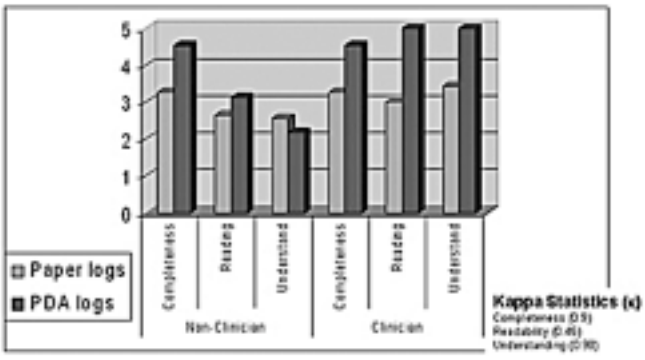
Purpose: We believe that use of a PDA database would keep better track of patient information while maintaining a higher degree of patient confidentiality when compared to a conventional paper log. We decided to investigate the feasibility, utility and convenience of using a customized PDA database for Pediatric Emergency Department (PED) patient follow-up.

Methods: Prospective convenience sample study of the residents' use of a PDA database for PED patient follow-up. Outcomes were measured by comparing the pre and post study survey, and data quality of the hand written paper logs & printed PDA logs by a clinician and a non-clinician reviewer blinded to the users. Results: Over a 4-month period (Nov 2003 to Feb 2004) 11 residents used the PDA application to track their patients during their Pediatric ED rotation. On a scale of 1-5 (1 = Very easy; 5 = Extremely difficult); the mean rating for ease of data entry was 2.27 (95% CI, 1.94 and 2.60) and for ease of data retrieval was 2.36 (95% CI, 1.94 and 2.60) and convenience of use was 3.75 (95% CI, 1.94 and 2.60). For data quality for completeness, readability, and understanding of the content of the data, both the clinician and non-clinician reviewer scored the printed PDA data quality significantly more complete ($P < 0.05$), and easily readable ($P < 0.05$) (Fig 1).

All participants agreed that use of a PDA database was more secure and made them less likely to violate patient confidentiality compared to using a paper log.

Conclusion: Our study suggests that use of a handheld computer may improve the quality of and security of patient data for tracking patient information in the emergency department.

Figure 1. Paper and printed PDA log evaluation scored in a scale of 1-5 (1= Extremely poor and 5= Excellent) by two reviewers.



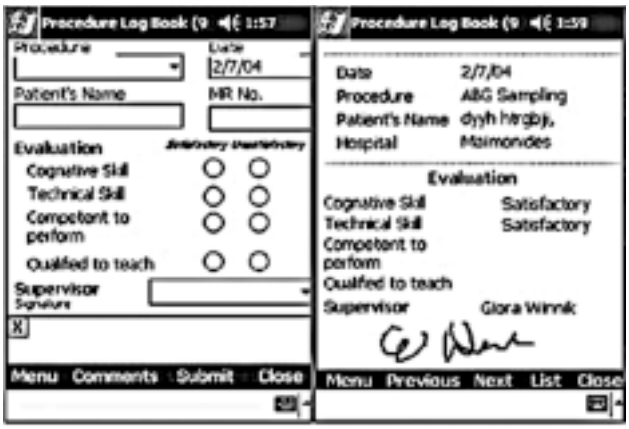
P2

Personal Digital Assistant (PDA) Database With Actual Signature of the Supervising Physician—An Innovative Procedure Evaluation Logbook for the Residents.

Abu NGA Khan, MD, MS.[1,2]

[1]Pediatrics, Morgan Stanley Children Hospital, College of Physicians and Surgeons, Columbia University, New York, NY; [2]Emergency Medicine, Maimonides Medical Center, Brooklyn, NY.

Figure 2.



Data entry interface Data Viewer

Purpose: As a requirement for credentialing, a residency program requires residents to maintain a log of procedures encountered in the emergency department (ED). Although, there are a few electronic procedure logbooks available, most of them are self-reporting system and does not include the evaluation signature of the supervising physician. Because of this limitation, many residency programs continued to use the standard paper procedure log.

Methods: We created a Pocket PC® operating system PDA data base (with password protection) for recording the procedure evaluation. Interface design is based on standard paper logbook. We focused on rapid data entry with minimum requirement for text, and field-level automation with a scribble control field for recording the actual signature of the supervisor (Fig 2). Once the data is submitted by the supervising physician, it becomes locked, no further editing option is available for the user. The database easily synchronizes with a desktop application. Residents could view each individual procedure evaluation and easily print a report sheet with all procedures and the actual image of the supervisors' signature. An institutional version of the application may be available to synchronize multiple residents' PDAs with one desktop database for the program director's record.

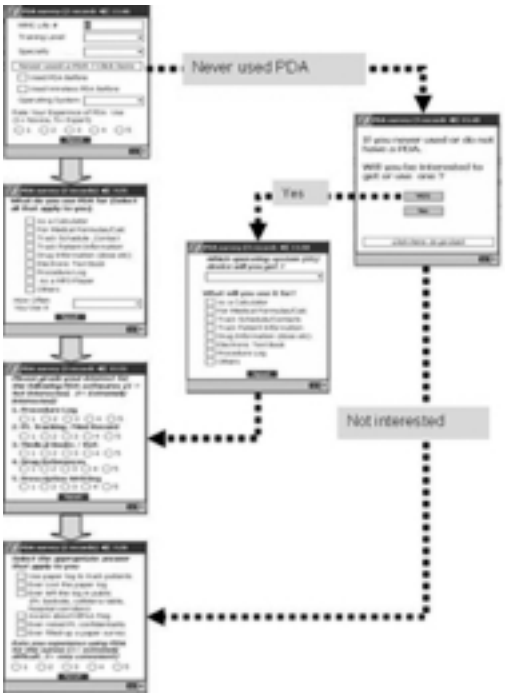
Conclusion: Use of a PDA application for easy tracking of procedures including the supervisor's signatures could be a great alternative to the conventional procedure evaluation logbook. In addition, this is less likely to be lost than a paper logbook and maintains a higher degree of patient confidentiality.

P3

Use of Personal Digital Assistant (PDA) as a Tool for Research Data Entry.

Abu NGA Khan, MD, MS,[1,2] Joshua Frank, MD,[3] Rajesh Geria, MD,[2] Steven J. Davidson, MD, MBA.[2]
[1]Morgan Stanley Children Hospital, Columbia College of Physicians and Surgeons, New York, NY; [2]Emergency Medicine, Maimonides Medical Center, Brooklyn, NY; [3]Pediatrics, Maimonides Medical Center, Brooklyn, NY.

Figure 3.



Purpose: The use of PDA technology for medical applications is opening a new field to research in recent years. We evaluated the feasibility, effectiveness and convenience of conducting a medical survey using a PDA device.

Methods: An interactive Pocket PC 2003® PDA application was developed using Visual CE® to conduct a survey among the physicians in a community hospital regarding their interest and experience with different PDA applications (Fig 3). Data points also included the participant's previous experience of taking a paper survey and their current experience of using the PDA for this survey. The software was programmed to track the time required to complete the questionnaire by each participant. Data was analyzed using SPSS® Ver. 12.0.

Results: About 85% (51/60) had prior experience of using a PDA. The mean time to complete the questionnaire was 2.4 minutes (95%CI: 2.18-3.02 minutes). About 57% of the current PDA users and 67% of the non-users had pervious experience of filling up a paper survey questionnaire. About 65% of the participants rated their experience of using PDA for this survey as very convenient with a mean rating of 4.56 (95%CI: 4.37-4.75) on a scale of 1-5 (1=extremely difficult and 5=very convenient). Neither the time to complete the survey nor the rating was significantly influenced by the participants' previous experience with PDAs (p=0.43).

Conclusion: Using a PDA for data collection may be a fast and effective alternative to traditional paper-based surveys. Direct data entry by the participants eliminates the cost, time and human errors in data entry, and enables tracking of users for longitudinal analysis.

P4

Discharge Analgesic Prescription Errors in Pediatrics: A Preliminary Study of 105 Patients.

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[1]Departments of Anesthesiology/Critical Care Medicine and Pediatrics, Johns Hopkins Medical Institutions, Baltimore, MD.

Purpose: Medication errors caused by mistakes in prescription writing are a common and preventable cause of iatrogenic injury and are more common in children. We investigated prescribing errors in pediatric patients receiving analgesics at the time of discharge.

Methods: With IRB approval, the investigators photographed and photocopied analgesic prescriptions and discharge forms of medical and surgical pediatric patients for whom the Pediatric Pain Service had been consulted. The prescriptions were written by the patient's primary medical or surgical service. Prescribing errors were analyzed and were classified as dose errors, missing information, and patient identification errors. Determination of medication errors and safe prescription writing practices were based on common guidelines. Errors were classified as potential adverse drug events (ADEs) if the error had the potential for patient injury. Medication errors and potential ADEs were reported as the percentage of prescriptions with errors. The clinical services observed were not informed of the study in order to avoid the Hawthorne effect. The Pediatric Pain Service rewrote any prescriptions which would be considered potential ADEs.

Results: 105 patients (M:F 64:41) were studied. Complete data was obtained in 77 (73%) of these patients. All patients were discharged on opioids and 6.5% with NSAIDs. There were 83 prescriptions analyzed and 50% of prescriptions had one or more errors. There were 2.4% of prescriptions (N=2) with the potential for significant medical injury and were considered potential ADEs. These events involved improper dosing of opioid medications. There was no weight recorded on 45% of prescriptions for patients weighing <40 kg. There was an incorrect name or patient identifier in 3.6% of prescriptions and discrepancies were noted between prescriptions written and the discharge data form in 9.7% of patients.

Conclusion: Discharge prescription errors for children receiving analgesic drugs are very common and some were potentially life-threatening. The authors are developing a computerized physician prescription writing program with weight-based dosing to reduce errors.

P5

Informatics-Based Approach for Evaluating PNP Student Performance.

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Purpose: The Institute of Medicine identified the critical role of information technology in designing safe and effective health care. To achieve this goal healthcare professionals must receive the requisite training during basic and advanced educational programs. As part of an overall project to promote evidence-based practice and integrate informatics competencies into the NP curriculum, we developed an informatics-based student clinical log. In this presentation, we illustrate how our approach supports analysis of PNP student adherence to evidence-based guidelines for well child care and asthma.

Methods: The sample for this descriptive study was 670 encounters of 8 students over 6 months. The architecture of the student clinical log system included personal digital assistants (PDAs), synchronization software, and Access database software. The structure of the PDA interface is constant across NP specialties, however, content was tailored to the PNP specialty. Data elements included demographics, past medical history, medical diagnoses, nursing diagnoses, and NP plan of care—diagnostics, procedures, teaching and counseling, referrals, and prescriptions. Students entered de-identified data into their PDAs and synchronized with the central database. Data reports were generated through database queries.

Results: The majority of the encounters involved Hispanic (68%) and Black (17%) children. The number of well child encounters was 236; 25% had no interventions. Most frequently ordered diagnostics were CBC, Hgb, and serum lead. The principal procedure was immunization (n = 223). More than 300 teaching interventions were documented including safety precautions (n=76), nutrition (n = 68), health promotion (n = 47), medication side effects (n = 19), and violence control (n = 13). In 9% of encounters, patients were referred to an MD. In asthma encounters (n = 60), the most common interventions were teaching (n = 78) and prescriptions (n = 74). The data suggest several areas of variation from guideline recommendations.

Conclusion: The system that we have developed is useful in monitoring the extent to which student performance is congruent with evidence-based guidelines.

P6

Assessing the Culture of Safety in a Children's Hospital.

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Purpose: In adult hospitals, perceptions of error, stress, and team work have been demonstrated to impact the occurrence of and response to medical errors and harmful events. The Safety Attitudes Questionnaire (SAQ) is a validated instrument that measures employee attitudes in the domains of job satisfaction,

Table 1. (Larsen, et al)

Domains	RNs (N=157)	RTs (N=17)	Techs (N=19)	Pharmacists (N=7)	MDs (N=32)	Hospital OR Staff (N=29)	OR MDs (N=12)
Teamwork*†	39%	18%	16%	0%	63%	31%	75%
Safety Climate*	69%	45%	47%	57%	41%	69%	83%
Working Conditions†	45%	27%	16%	14%	28%	28%	67%

*$P < 0.01$ MDs vs all others. OR analyzed separately.
†$P < 0.02$ OR MDs vs OR staff.

perceptions of management, teamwork, safety climate, working conditions, error reporting and stress recognition (Sexton BMJ 2000). Limited research has sought to address these issues within children's hospitals. Assessment of safety climate using the SAQ is a key step to effectively focus interventions to improve the safety of hospitalized children.

Methods: During the winter of 2002/2003 the SAQ was administered to the staff of a 242-bed, academic, free-standing children's hospital. The percentage of favorable responses on average was calculated for each domain by hospital position. Chi-square tests were used to assess differences.

Results: We achieved a 67% response rate (267/400) representing 37% of all personnel who averaged 9 years of employment with our institution. The table presents the percentage of caregivers who agreed with the statements comprising each domain on average. There was a significant difference in perceptions of teamwork between hospital physicians and all other staff; this was also true in the operating room. Recognition of the impact that stress and fatigue play in job performance was low (19%) yet job satisfaction was relatively high (68%). Perceived support by management of error reporting was low across all groups (35%). (Table 1.)

Conclusion: Recognition of stress and fatigue are generally low in both pediatric and adult hospitals. Efforts to improve the safety climate will be directed towards improving teamwork, error reporting, and stress recognition.

P7

Using the Continuity of Care Record to Share Immunization and Growth Records.

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Purpose: The Continuity of Care Record (CCR) is an ASTM Standard for exchange of core clinical information when a patient changes healthcare provider. It was approved on April 6, 2004 and is sponsored by the AAP, AAFP, AMA, and MMS. Ease of use will be critical to rapid adoption of this new standard.

Methods: The CCR Standard is based on the use of XML to generate a document that is both human readable and machine readable. A web application was developed using Macromedia ColdFusion to catpure basic CCR data elements and store them in a Microsoft SQL database for output in XML format. Data entered on multiple individual CCRs was merged into a single CCR containing a complete immunizations record, growth chart, problem list, medication list and patient demographics. A sample of three records was used to prepare a demonstration of the concept of using the CCR to repace photocopied records or manual summaries. The samples were stored on USB disks, transmitted using a secure Email web portal, and printed on paper. Comparison was made of data entry at simulated visits and a single task of form completion.

Results: The total time to enter growth and immunization data is greater when complete immunization records and vital signs are entered by nurses at the time of the visit than if only immunization dates are entered when a copy of immunization records are completed.

Conclusion: The CCR is an effective tool for sharing core child health maintenance information with patients and other physicians. The best strategy for preparing CCRs is to enter the information routinely at all child health visits using terminals in the nursing station rather than to enter the data at one time when a patient requests immunization records. The basic patient summary stored as a CCR can be read by patients or the next primary care Physician using a web browser and an XSL stylesheet to format a printout. It is possible to use the CCR for records transfer even in the absense of a complete Electronic Medical Record System. Completion of a CCR at each well child visit allows maintenance of single immunization record even when the patient moves from one practice to another.

P8

Use of a Novel Pediatric Body Composition Technique for Assessing Body Fatness in Infants.

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Purpose: The assessment of body composition provides key information for assessing infant growth and for the administration of

nutritional and/or pharmacological interventions. However, the use of body composition methods in infants is limited due to practical considerations, accuracy, and safety. This study evaluated the intra-device reliability and accuracy of an air displacement plethysmograph, the PEA POD® Infant Body Composition System (Life Measurement, Inc., Concord, CA), for determining percent body fat (%BF) in infants.

Methods: The PEA POD intra-device reliability was assessed by comparing %BF obtained from same-day repeated tests in 14 pre- and full-term infants (4.9–17.7 wks; 2.7–6.4 kg). A 4-compartment (4C) model for calculating %BF based on measurements of total body water via deuterium dilution, total body potassium via whole body counter, and bone mineral content via dual-energy x-ray absorptiometry, was used as the criterion method for evaluating the accuracy of %BF estimates from the PEA POD in 10 infants (2.7–23.0 wks; 4.1–7.1 kg).

Results: There was no significant difference in test-retest mean %BF (Δ=0.03±1.42 %BF). Within-subject test-retest mean SD and CV were 0.6 %BF, and 3.3 %, respectively, indicating excellent intra-device reliability. %BF estimates obtained from the PEA POD were not influenced by subject behavioral state. The regression between %BF by the 4C model and by PEA POD did not significantly deviate from the line of identity [%BF(4C model)= 0.95%BF(PEA POD)+3.33, R^2=0.84, SEE=2.58 %BF]. Bland-Altman limits of agreement (-7.05–2.79 %BF) indicated smaller variations in individual agreement between the PEA POD and the criterion method compared to other pediatric body composition techniques. Further, agreement between %BF estimation by PEA POD and 4C model did not vary with body fatness (r=-0.06), and the aqueous (partial r=0.50) or mineral (partial r=-0.02) fractions of fat-free mass.

Conclusion: The PEA POD is a reliable and accurate instrument for determining %BF in infants and, because of its easy and fast test procedure, has the potential for widespread use in both research and clinical settings.

P9

Web-Based Eligibility Survey for the Intranasal Flu Vaccine.

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Purpose: We assessed the feasibility of a web-based eligibility survey for the intranasal influenza vaccine ("Flumist," Wyeth Vaccines, Philidelphia, PA). Flumist was introduced during the 2003-2004 flu season and had many exclusions for its use. The epidemic flu season created demand for Flumist and placed great communication burdens on the pediatric office.

Methods: Using manufacturer provided vaccine information, a proprietary web page was designed in HTML format with Microsoft Word. The web document described Flumist, its costs, listed 17 exclusion criteria and provided links to a manufacturer web site and CDC and AAP web postings on influenza. The web page was posted to our pediatric office website hosted by the AAP/AMA joint venture, MEDEM. Parents who called and expressed an interest in Flumist were referred to this web page. After reviewing the web page, parents called the office if they elected to have their child immunized with Flumist. At the appointment, we reviewed a copy of our web page with parents to assure appropriateness for this vaccine.

Results: We estimated that a phone nurse took 5 minutes or longer to describe the vaccine and to review the exclusion criteria with a parent. By comparison, we estimated that referral to our informational web page would take 45 seconds. This form of information sharing was well received by the office staff and by parents.

Conclusion: A web-based survey to assess eligibility for Flumist proved effective, inexpensive, and easy to implement. This was a means of providing accurate and consistent information about the product and could prevent inappropriate office visits or immunization for ineligible patients. In a busy pediatric office, this survey provided efficient referral to in-depth information and allowed office staff to more effectively manage other phone calls.

P10

The Pediatrician's Office as a Primary Community Resource for the National Center for Missing and Exploited Children (NCMEC) and the Amber Alert System.

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Purpose: Digital identification of children is the preferred method of the NCMEC and law enforcement agencies to launch immediate and effective missing child searches such as Amber Alerts. Family Trusted® Digital ID (FTDID) was created at the request of the NCMEC to help fulfill its mission to bring missing children home safely. As NCMEC's only approved form of digital identification for children, FTDID is the national standard, and includes the many legal and information requirements necessary to launch such searches.

Methods: FTDID provides kits containing all materials for each 200 digital IDs. A digital camera 2x2x1 inches in size weighing less than 1 pound, patient specific identifying information sheets and educational pamphlets, waiting room posters, and recommended marketing materials are included, with instructions for set-up and use. A PC of any kind is needed.

Set-up time is 2 min. (once only). Actual total ID process time per child is 90 sec. Children <1 yr are usually not ID'd but can be if so desired.

All information goes on a floppy disk taken by the parents and is completely erased in the computer (no HIPAA issues).

Cost structure: office cost per child - $7; suggested cost to patient - $15. Updated photos are recommended yearly ($5 practice/$10 patient). Cost to patient is determined by each practice and can be higher or lower at their discretion, depending on their circumstances, expenses, and patient population.

Results: In the typical individual practices studied seeing 50 patients per day >1 yr old, 12 will be ID'd at time of appointment without need for further discussion. 25 will take the information with them and schedule the ID at the time of the next medical appointment or a separate time designated by the office for the ID only. (75% overall acceptance rate).

Nearly 100% acceptance rate is noted in: parental divorce or unstable marital situations of any kind, travel plans that involve the child within the next six months, and mothers of teenage daughters (the child often requests the ID!)

Conclusion: The FTDID program permits pediatricians to offer a much needed service to their patients, and the community.

P11

Readability of Electronic Responses of Clinicians to Consumers Perinatal Health Care Questions.

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Purpose: Consumers of health care services are increasingly becoming consumers of health care information. Consumer-directed health care resources, both printed and online, are frequently written at reading levels making the information unavailable to significant portions of the population. The significance further underestimated since conventional readability analyses focus on the number of words in sentences and syllables in words not taking into account the use of technical words. Our objective was to determine the readability of patient directed health care information by conventional scores and the use of undefined technical terms.

Methods: We reviewed publicly available de-identified questions consumers submitted by e-mail and the clinician's response in the "Ask an Expert" section of NetWellness.org, a consumer information source. Participating clinicians represented multiple disciplines.

The first 200 questions/answer pairs in both the pregnancy and newborn care sections were analyzed. For each answer, health care-related technical terms that were present but neither used in the question nor defined in the answer were identified. Using Microsoft Word, the Flesch Reading Ease (100 point scale, >70 considered "easy") and Flesch-Kincaid Grade Level scores were calculated.

Results: The 400 clinician responses were analyzed. Undefined health care terms were used in 63 (15.8%) of the answers. The mean Flesch Reading Ease score was 46.8 (SD 13.3) and Flesch-Kincaid Grade Level score was 10.5 (SD 1.7). Answers had a mean of 117 words (SD 105). To determine if short text size modified the results, responses from all answers are combined (46,874 words) and analyzed. This single text had a Reading Ease score of 47.7 and Flesch-Kincaid Grade Level score of 10.9 grade very similar to the individual answer analysis.

Conclusion: Even in direct answers to consumer requests for information, clinician responses were written with a readability level that is considered too high for consumer materials. In addition, clinicians frequently used undefined technical terms. This study is limited by the use of a single website and relatively narrow topic domain.

P12

Comparisons of Internet Usage Characteristics by Youth Self-Reported Depressive Symptomatology.

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Purpose: The first step in building a successful targeted intervention online is to understand how young people *use* the Internet. Childhood major depressive disorder is a significant public health issue. Using data from the Youth Internet Safety Survey (YISS), Internet usage characteristics of youth who report major depressive symptomatology are described.

Methods: The YISS was a nationally representative telephone survey of youth (ages 10-17) who used the Internet (N=1,501). The current investigation compares self-reported usage characteristics based upon depressive symptomatology. Three categories were created based upon *DSM-IV* criteria: 1) Major (5+ symptoms of major depression and functional impairment), 2) Minor (3+ symptoms of major depression), or 3) Mild/none (fewer than 3 symptoms of major depression).

Results: Five percent of young Internet users report current symptoms of major depression. Frequency of Internet use does not significantly vary based upon report of depressive symptomatology ($P > .05$), although respondents who indicate major depressive symptomatology are significantly more likely ($P < .001$) to report intensive Internet use (3+ hours/day). Youth are equally likely to rate themselves as expert Internet users regardless of their report of depressive symptoms ($P < .05$). Although the majority of youth access the Internet most frequently at home, 30% of youth reporting major depressive symptomatology accessing the Internet

most frequently at school. The three common activities for which young people with major depressive symptomatology use the Internet are e-mailing (34%), chat rooms (17%), and gaming (17%).

Conclusion: Results suggest that online interventions may be a viable mode of service delivery. Youth with depressive symptomatology indicate they are comfortable using the Internet and use it as frequently as other youth. Developers of online programs need to consider privacy issues that affect youth who do not have access to a private workstation such as in a school setting. Creators of website-based programs might integrate innovative e-communication strategies (eg, chat rooms, e-mail) into their therapeutic interventions.

P13

Utilizing the World Wide Web to Write a Textbook to Enhance Faculty Professional Development.

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Purpose: Professional development includes teaching, research and academic writing. Opportunities to teach are readily available. Research requires training and initiative. The opportunity to write for a textbook is largely limited to academic leaders in a specialty. The World Wide Web (WWW) is a new publishing option as well as a new option for communication between textbook editors and chapter authors. The purpose of this report is to describe a method to increase the opportunity for faculty to contribute textbook chapters.

Methods: An outline of 22 sections was developed. Each section was assigned to one of four editors. Editors recruited authors for chapters within their sections. Chapters were submitted to the editors for editing and posting on the WWW.

Results: This project began in June 2001 and the final textbook was submitted for publication in October 2003. Chapters that were completed early, were posted on the WWW which permitted additional review by the authors facilitating communication with the editors. These chapters posted on the WWW as a textbook in progress, were available as a partial web resource. The additional lead time on the WWW also permitted indexing and identification by internet search engines (eg, Google), so that by the time the textbook was completed, most major search engines had already identified the on-line textbook. Page/type-setting was streamlined by the electronic transfer of the equivalent on-line chapter files to the publisher. Of the 214 chapters, 41 chapters were contributed by 18 senior faculty, 51 chapters were contributed by 29 junior faculty, 46 chapters were contributed by 23 community pediatricians, 38 chapters were contributed by 27 residents, and 40 chapters were contributed by 37 medical students.

Conclusion: The WWW provides a new forum for publishing a textbook. It also provides a new communication option between editors and authors to better coordinate the content and editorial style of the chapters. A textbook project such as this provides faculty with the opportunity to contribute to the medical literature enhancing their professional development.

P14

Improving Immunization Compliance Using a Web-Based Tracking System.

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Purpose: Immunization rates increased dramatically in the United States in the mid-1990s. Yet, despite clear standards and goals, physicians do not achieve the desired rate (90%) for immunization coverage. Poor compliance is partially explained by a lack of immunization tracking systems and self-audits. At MetroHealth Medical Center (MHMC), our electronic medical record system (EMRS) does not have the capability to track immunization status. As part of a quality improvement effort, we have developed a dynamic web-based immunization tracking system (ITS), which not only tracks immunizations, but also provides recommendations following the American Academy of Pediatrics (AAP) guidelines at the point-of-care.

Methods: ITS, written in PHP language, allows physicians to list their own patient roster. It also determines which immunizations are required to fulfill the AAP recommendations. ITS extracts its data from a mySQL database, which in itself is a subset of the original database employed by our EMRS. Following our creation of ITS, we conducted a survey among all our pediatric residents at MHMC for feedbacks.

Results: We have conducted a survey on 22 pediatric residents working at MHMC regarding ITS. 50% of residents are dissatisfied with the inability to track immunizations in our EMRS. 45% of residents believe that they are currently not meeting the AAP guidelines for immunizations. 91% of residents rated ITS as “very useful.” Finally, 95% of residents reported they will very likely put ITS to use.

Conclusion: To achieve the desired rate for immunization coverage, we need better tools to track our patients. From our survey, we have determined that ITS may not only contribute to a better outcome in compliance, but also decrease the current level of frustration among housestaff with our current EMRS. Finally, further formal studies will be required to investigate the true effect of such system on immunization compliance.