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Use of an Electronic Medical Record Improves the Quality of Urban Pediatric Primary Care

William G. Adams, MD; Adriana M. Mann; and Howard Bauchner, MD

ABSTRACT. *Objective.* To evaluate the quality of pediatric primary care, including preventive services, before and after the introduction of an electronic medical record (EMR) developed for use in an urban pediatric primary care center.

Methods. A pre-postintervention analysis was used in the study. The intervention was a pediatric EMR. Routine health care maintenance visits for children <5 years old were reviewed, and documentation during pre-intervention (paper-based, 1998) and postintervention visits (computer-based, 2000) was compared.

Results. A total of 235 paper-based visits and 986 computer-based visits met study criteria. Twelve clinicians (all attendings or nurse practitioners) contributed an average of 19.4 paper-based visits (range: 5–39) and 7 of these clinicians contributed an average of 141 computer-based visits each (range: 61–213). Computer-based clinicians were significantly more likely to address a variety of routine health care maintenance topics including: diet (relative risk [RR]: 1.09), sleep (RR: 1.46), at least 1 psychosocial issue (RR: 1.42), smoking in the home (RR: 15.68), lead risk assessment (RR: 106.54), exposure to domestic or community violence (RR: 35.19), guns in the home (RR: 58.11), behavioral or social developmental milestones (RR: 2.49), infant sleep position (RR: 9.29), breastfeeding (RR: 1.99), poison control (RR: 3.82), and child safety (RR: 1.29). Trends toward improved lead exposure, vision, and hearing screening were seen; however, differences were not significant. Users of the system reported that its use had improved the overall quality of care delivered, was well-accepted by families, and improved guidance quality; however, 5 of 7 users reported that eye-to-eye contact with patients was reduced, and 4 of 7 reported that use of the system increased the duration of visits (mean: 9.3 minutes longer). All users recommended continued use of the system.

Conclusion. Use of the EMR in this study was associated with improved quality of care. This experience suggests that EMRs can be successfully used in busy urban pediatric primary care centers and, as recommended by the Institute of Medicine, must play a central role in the redesign of the US health care system. *Pediatrics* 2003;111:626–632; *electronic medical record, computer-based, primary care, quality, child health services.*

ABBREVIATIONS. EMR, electronic medical record; RR, relative risk; CI, confidence interval; PPCC, pediatric primary care center; ARCH, Automated Record for Child Health; SEF, structured encounter form; RHCM, routine health care maintenance; WIC, Women, Infants, and Children; PPD, purified protein derivative.

Standards of quality in pediatric primary care have been developed by the American Academy of Pediatrics, American Academy of Family Medicine, the US Maternal and Child Health Bureau, and the US Public Health Service.^{1–5} Although recommendations from these groups are not always the same, many of the core elements—risk assessment, screening, immunization, and guidance—are similar. Nonetheless, considerable practice variation has been observed both within and between practice groups. Interventions to improve the quality of pediatric primary care have most often been limited to 1 or 2 components such as immunization delivery or injury prevention,^{6–8} although recent practice- and community-based systems have successfully improved the delivery of multiple preventive services.^{9,10} Successful elements in these office systems included identifying service needs, prompting of providers, education of patients, documentation of services, simplified chart screening, follow-up tracking, and monitoring effectiveness.⁹

Electronic medical records (EMRs) have been proposed as one way to reduce practice variation and improve quality by improving access to patient data, efficiency of documentation, prompting of clinicians, decision support, presentations of data, and access to educational materials for patients. A number of commercial companies and some academic medical centers have built and implemented successful ambulatory EMRs. Nonetheless, few pediatric clinicians routinely use an EMR at the point-of-care, and many clinicians have resisted the transition to EMR. Possible reasons for clinician resistance include perceived disruption of a demanding clinical workflow, usability of available software, negative previous experiences using computers, limited support at the point-of-care, and high cost of available systems.

Only 2 published studies have evaluated the use of EMRs to improve the delivery of pediatric preventive services. One study evaluated the use of scannable forms, and the other was a documentation tool for guideline-based care. Both studies were conducted in resident-based clinics.^{11,12} No published studies have evaluated the use of a comprehensive

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EMR by attending level pediatric clinicians and nurse practitioners at the point-of-care.

In this study, we evaluated the quality of documentation and delivery of pediatric primary care, including preventive services, before and after the introduction of an EMR developed for use in an urban pediatric primary care center (PPCC).

METHODS

Setting

The study was conducted at the Boston Medical Center PPCC. The PPCC is located in inner-city Boston and has >28 000 patient visits annually. The clinic primarily serves children who are from low-income families with minority ethnicity (35% African American, 15% Haitian American, 30% Latino, 10% Portuguese-Creole, and 10% other groups).

Study Design

A pre-postintervention analysis was used in this study. The intervention was a pediatric EMR, the Automated Record for Child Health (ARCH), described below. Preintervention (paper-based) visits were documented on paper using structured encounter forms (SEF; Fig 1). For this group, all nonacute care visits to the PPCC during 2 weeks in July and 2 weeks in August 1998 were photocopied at the time of the visit and later reviewed. For the postintervention (computer-based) group, data for visits documented using the ARCH during April through November 2000 were reviewed. A visit was included if 1) a reason for the visit included routine health care maintenance (RHCM); 2) the child was <5 years old on the day of the visit; and 3) the visit was documented by an attending physician or nurse practitioner who had at least 2 weekly primary care sessions. A clinician was considered to have successfully adopted the ARCH and was included in the computer-based group if he/she saw 50 or more

children using the ARCH during the study period. Items evaluated included interim health history; risk assessment; developmental screening; physical examination; anticipatory guidance; immunizations; and hearing, vision, lead, anemia, and tuberculosis testing. Items evaluated were chosen by the authors based on published guidelines from the American Academy of Pediatrics, Bright Futures, and the US Preventive Services Task Force. Each item was coded as being addressed or not addressed within the visit documentation. For paper-based documentation, items were further coded as having been documented using some or all of the following: item-specific check mark, group check mark, yes or no answer, or free text description. A research assistant with 5 years of clinical experience in pediatric primary care settings reviewed all paper records using structured data extraction forms developed in collaboration with the other investigators. The principle investigator was consulted for all clinical vocabulary and legibility questions. Computer-based visit notes were not reviewed individually; these data were obtained directly from the clinical database. Computer-based clinicians were also able to type comments during the visit. Questions were considered addressed if they had a yes/no response or typed text. The ARCH allowed users to designate anticipatory guidance topics as either printed or discussed (Fig 2). A guidance topic was considered "addressed" if it was discussed or printed during computer visits.

The number of visits eligible for the study varied for each clinician depending on the proportion of visits for RHCM, number of clinical sessions (range: 2-7), vacation schedules, and ward attending responsibilities. The sampling period for paper-based visits was used to identify 200 to 250 eligible visits. The sampling period for computer-based visits was used to maximize the number of eligible visits after full implementation of the EMR.

The study was designed to evaluate 3 primary hypotheses. First, that a comprehensive EMR could be designed and successfully implemented in a busy urban primary care center. Second, that the quality of documentation of a comprehensive set of primary care measures would improve after introduction of the EMR. Third, that specific outcomes such as immunization status

Four Year Old Exam
8-12-98

History

- Interview the child during the visit
- Illnesses
- Injury
- Diet
- Enuresis/Encopresis
- Dental visits
- Sleep
- Development/Behavior
 - hyperactivity
 - social interaction
 - peer relations
 - recklessness and destructiveness
 - shyness
 - fears
 - jealousy
 - counts to 10
 - 3-4 colors
 - dresses with help
 - draws a person (face, arms or legs)
 - make-believe play
- Family Concerns
 - unusual stresses
 - work and child care issues
 - privacy practices
 - sibling and parental interaction

Handwritten notes:
 Ylbon ♀ zrron for wcc.
 Mom concerned z frequent
 cough - dry, aple, not PM
 sis z in chuney's. Has
 been out of school also
 z it. Has used tawstin
 past - no longer working.
 needs varicella
 CBC/Pb R ple bmar
 wic R
 Social: mom @ home. Family
 intact
 School going to HS
 program z doing
 well
 Dev: counting to 20, colors,
 #, loves books.
 Elim
 Sleep } z problems.

Physical
 VS: Wt 62 lbs, % 116.5 cm
 P 100% R 100% B/P 96/46
 App >100%
 Skin
 HEENT - hearing, vision
 Cor
 Chest
 Abd
 GU
 Ext
 Neuro
 DDS
 ELM
Handwritten notes:
 normal exam
 Lungs clear z wheezes

Anticipatory Guidance

- Nutrition: pleasant mealtime atmosphere, small portions of food, with seconds
- Accident Prevention: car safety, toy safety, smoke alarm, electrical safety, street safety, water safety, teach child what to do in case of fire, teach child their name, address and telephone #, avoid wild berries, stranger safety, dogs, sunblock, matches
- Interaction and Discipline: sexual curiosity normal - be natural and truthful, basic sex/death education, promote interaction with playmates, explore new places, challenge child to "figure things out", show interest in child's daily activities, give reprimands privately, clear explanations, positive praise, independence balanced with limits, games, reading
- Toilet training: By age 4, 95% of children are bowel trained, 50% are dry in the daytime, and 75% at night
- Nursery school
- Outside excursions (200)

Plans

- DPT #5 + OPV #4 (4-6 years old)
- Vision Screen
- Hearing Screen
- PPD (risk groups)
- RIC at 5 years old

Handwritten notes:
 CBC/Pb
 Varicella vaccine
 RTC
 6 months
 Vitamin D 2 puff pm
 Well child
 ? cough variant RAO
 Eucasant
 J. J. J.

DIAGNOSIS
 Well child
 ? cough variant RAO

Screening: U/A, CBC, Vision

PROVIDER

Fig 1. Sample paper-based SEF.

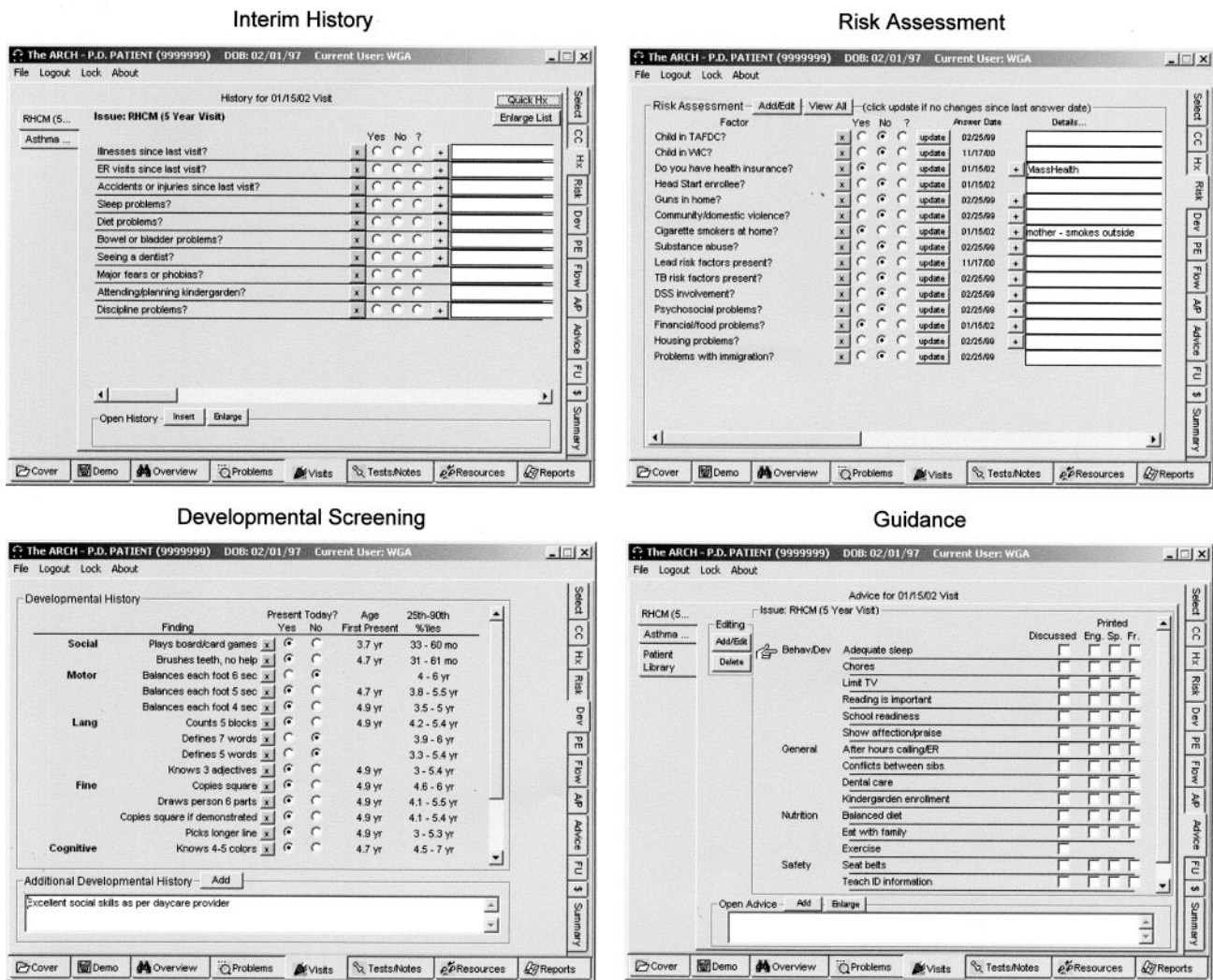


Fig 2. Sample sections of computer-based visit.

would improve with use of the EMR. Neither the research assistant nor study clinicians were aware of specific study hypotheses.

To ensure that clinicians who contributed computer-based visits were similar to those who contributed only paper-based visits, data from paper-based visits were also compared for the 2 groups.

The ARCH

The ARCH is a pediatric EMR developed by the authors using client-server software development tools.¹³ The ARCH uses a “point-and-click” interface with a design suggestive of a traditional paper record (Fig 2). Computers with touch-enabled palettes were placed in each examining room and throughout the clinic so that clinicians could document each visit. In addition to documentation of RHCM visits while seeing patients, the ARCH also allowed clinicians to maintain problem and medication lists; monitor growth; record obstetrical history, past medical history, and family history; view limited laboratory data; link to Internet-based resources for patients; and print reports including Women, Infants, and Children (WIC) and school physical forms.

In 1998, 8 clinicians (6 attending-physicians and 2 nurse practitioners) agreed to use the ARCH to document patient encounters during RHCM visits. Two additional clinicians joined the study in 1999. Each clinician received 2 hours of initial training and then began by using the EMR to see 1 patient per clinical session with the research assistant available for support. Clinicians were allowed to increase the number of patients seen using the EMR at their own pace. The research assistant was available by page daily and made frequent visits to the clinic to provide support and teaching. One study clinician left the practice after using the ARCH for only 2 months, and 2 clinicians never used the ARCH

to see >50 patients during the study period and were excluded from computer-based visit analysis.

Statistical Analysis

Statistical significance testing was performed using Yates corrected χ^2 test for comparison of categorical data and the *t* test for comparison of continuous data. Differences were considered statistically significant for $P < .05$.

User Satisfaction and Feedback

In April 2001, users of the ARCH completed a 2-page survey to evaluate ease of use, workflow implications, and recommendations of use by others. Users were asked to indicate whether they strongly agreed, agreed, were neutral, disagreed, or strongly disagreed with 20 questions. The questions were grouped into 2 categories—“potentially beneficial” and “potentially problematic” (survey available on request).

Institutional Review

The Boston Medical Center Institutional Review Board approved this study.

RESULTS

Two hundred thirty-five paper-based visits (on SEF) and 986 computer-based visits met study criteria. The mean age of children in the paper-based group was 17.4 months compared with 17.9 months

for children in the computer-based group. Twelve clinicians contributed an average of 19.4 paper-based visits each (range: 5–39) and 7 clinicians contributed an average of 141 computer-based visits (range: 61–213). All 7 computer-based clinicians also had paper-based visits.

A similar proportion of computer- and paper-based visits included documentation of the “core” pediatric RHCM history questions relating to interim illness and elimination (Table 1). Computer-based visits were significantly more likely to have addressed diet, sleep, and psychosocial issues. For example, sleep issues were addressed 1.46 times more frequently by computer-based clinicians. Both computer- and paper-based clinicians were prompted for answers in all 5 areas at all visits for children under 5 years old. Although computer-based visits were more likely to contain at least some documentation on these core pediatric issues, SEF and computer-based visits differed in the likelihood of having text descriptions for questions when answered. Paper-based clinicians used either a check mark, “wnl”, or “yes, no, or ?” for 27.1% of answers and a written comment for 81.8% of answers. The ARCH limited clinicians to “yes, no, or ?” answers or typed comments. Computer-based clinicians used only “yes/no/?” for 86.9% of answers and typed comments for 13% of answers.

Substantial differences in the documentation of risk assessment were observed (Table 1). Paper-based encounter forms did not contain specific prompts for any of the items noted in the Risk Assessment section of Table 1; however, all are recommended for assessment during RHCM visits. Paper-based encounter forms did have a general prompt for parental stress. For computer-based visits, risk assessment questions were offered to clinicians in a dedicated section (Fig 1). Computer-based visits

were significantly more likely to contain specific references to nearly every item in the list. Differences in documentation prevalence were large for every issue except documentation of enrollment in the WIC Program, and access to dental care. For example, screening for smoking in the family and domestic/community violence increased 16- and 35-fold, respectively (Table 1).

Evaluation of developmental milestones documentation was limited to the presence of at least 1 milestone in the areas of language, motor, and social development within the visit note. Clinicians using the ARCH were significantly more likely to include at least one motor or social developmental milestone (Table 1). The greatest differences were seen in the documentation of behavioral and social milestones. For example, computer-based clinicians were 2.49 times more likely to record at least one behavioral or social milestone.

Height and weight and physical examination were documented for nearly all computer- and paper-based visits (Table 2). However, a physical examination was documented significantly more frequently during computer-based visits.

Six anticipatory guidance topics were evaluated (Table 2). Computer-based visits were significantly more likely to contain documentation of anticipatory guidance in all but one of the areas evaluated. Largest differences were seen in the areas of sleep position counseling (relative risk [RR]: 9.29), poison center control information (RR: 3.82), and the importance of reading (RR: 3.03).

The proportion of children “on-schedule” for recommended preventive services (Table 2) was only significantly different in two areas—immunizations and purified protein derivative (PPD) administration. Of note, there was a full-time immunization outreach coordinator in the clinic until 1999 and

TABLE 1. Documentation of Interim Health History, Risk Assessment, and Developmental Milestones During Computer- and Paper-Based Visits

	Computer		Paper		RR (95% CI)
	<i>n</i>	No. (%) Present	<i>n</i>	No. (%) Present	
Interim health history					
Interim illness	986	934 (94.7)	235	212 (90.2)	1.05 (1.00, 1.10)
Diet	986	924 (93.7)	235	202 (86.0)	1.09 (1.03, 1.15)
Elimination	986	743 (75.4)	235	168 (71.5)	1.05 (0.97, 1.15)
Sleep	986	921 (93.4)	235	150 (63.8)	1.46 (1.33, 1.61)
Any psychosocial issue	986	938 (95.1)	235	157 (66.8)	1.42 (1.30, 1.56)
Risk assessment (age range: mo)*					
Smoking in the home	986	592 (60.0)	235	9 (3.8)	15.68 (8.24, 29.81)
Lead risk factors	986	447 (45.3)	235	1 (0.4)	106.54 (15.05, 754.09)
TB risk factors	986	443 (44.9)	235	3 (1.3)	35.19 (11.41, 108.57)
Domestic/community violence	986	439 (44.5)	235	3 (1.3)	34.88 (11.31, 107.59)
WIC enrollment (0–35)	808	426 (52.7)	192	20 (10.4)	5.06 (3.33, 7.70)
Childproofing (6–59)	699	343 (49.1)	162	1 (0.6)	79.49 (11.25, 561.76)
Guns at home (12–59)	525	263 (50.1)	116	1 (0.9)	58.11 (8.24, 409.83)
Dental care (30–59)	227	173 (76.2)	51	23 (45.1)	1.69 (1.24, 2.31)
Developmental milestones†					
Language	986	690 (70.0)	235	153 (65.1)	1.07 (0.97, 1.09)
Motor	986	729 (73.9)	235	150 (63.8)	1.16 (1.04, 1.28)
Behavior/social	986	648 (65.7)	235	62 (26.4)	2.49 (2.00, 3.10)

TB indicates tuberculosis.

* Analysis restricted to age-appropriate range.

† At least 1 developmental finding in each category.

TABLE 2. Documentation of Physical Examination, Anticipatory Guidance, and Performance of Preventive Services During Computer- and Paper-Based Visits

	Computer		Paper		RR (95% CI)
	<i>n</i>	No. (%) Present	<i>n</i>	No. (%) Present	
Physical examination					
Height and weight performed	986	953 (96.7)	235	227 (96.6)	1.00 (0.97, 1.03)
Physical examination documented	986	966 (98.0)	235	218 (92.8)	1.06 (1.02, 1.10)
Guidance (age range: mo)*					
Sleep position (0–4)	218	124 (56.9)	49	3 (6.1)	9.29 (3.08, 27.98)
Breastfeeding (0–4)	218	142 (65.1)	49	16 (32.7)	1.99 (1.32, 3.02)
Poison Center information (9–35)	427	110 (25.8)	89	6 (6.7)	3.82 (1.74, 8.41)
Importance of reading (9–35)	427	276 (64.6)	89	19 (21.3)	3.03 (2.02, 4.54)
Dental care advice (30–59)	427	149 (34.9)	51	11 (21.6)	1.62 (0.94, 2.77)
Child proofing/safety	986	707 (71.7)	235	131 (55.7)	1.29 (1.14, 1.45)
Immunizations and other preventive services (age range: mo)†					
Immunizations	986	825 (83.7)	235	207 (88.1)	0.95 (0.90, 1.00)
Hemoglobin (9–23)	306	261 (85.3)	63	52 (82.5)	1.03 (0.91, 1.17)
Lead (9–23)	306	242 (79.1)	63	42 (66.7)	1.19 (0.99, 1.43)
Tuberculosis (12–59)	525	237 (45.1)	117	82 (70.1)	0.64 (0.55, 0.75)
Vision (36–59)	178	89 (50.0)	42	18 (42.9)	1.17 (0.80, 1.70)
Hearing (36–59)	178	86 (48.3)	42	14 (33.3)	1.45 (0.92, 2.28)

* Analysis restricted to age-appropriate range.

† At least 1 test or procedure performed in period 365 before the visit through 7 days after the visit.

immunization status was determined based on data present in the database during November 2001. Hence, the paper-based study period included outreach activities as well as 2 additional years for entry of missing immunization data. Children in the computer-based group were also significantly less likely to have received a PPD in the year before or on the visit date; however, tuberculosis recommendations had changed between 1998 and 2000, and this would be expected. Computer-based children 9 months old to 23 months old were 1.19 times more likely to have had a lead screening during the 365 days before or 7 days after the visit; however, the difference was not statistically significant (Table 2). A trend toward increased screening for hearing and vision was seen; however, only a relatively small number of study children were 36 months old to 59 months old, and these differences were not statistically significant.

Paper-based data were reviewed to evaluate possible differences between computer-based clinicians and those who had only contributed paper-visits. No significant differences were found in documentation of any item listed in Tables 1 or 2 except that computer-based clinicians were significantly more likely to have recorded a physical examination (RR: 1.10; 95% confidence interval [CI]: 1.01, 1.19) and signifi-

cantly less likely to have addressed the importance of reading (RR: 0.25; 95% CI: 0.09, 0.69) and childhood safety/injury prevention (RR: 0.62; 95% CI: 0.50, 0.78) during the paper-based period.

EMR Acceptance

Six of the 7 computer-based clinicians reported using the ARCH for 95% to 100% of nonurgent care visits. One user reported using The ARCH ~50% of the time (Table 3). Nearly all users agreed that the ARCH was easy to use, increased completeness, and reminded them to do things that they might otherwise forget. Most users also agreed with the statement that The ARCH was well-accepted by families. Nearly all users also agreed that the ARCH improved the quality of guidance given to families. Importantly, however, 4 of 7 users felt that the system extended the duration of visits (mean: 9.3 minutes longer; range: 5–15 minutes), and 3 felt that using the system caused them to leave the clinic later. Most users also agreed with the statement that use of the ARCH reduced eye-to-eye contact. However, despite these responses, all users agreed that the system should continue to be used and recommended its use to other pediatric practices.

TABLE 3. Clinician Assessment of Computer-Based Visits (*n* = 7)

"Compared to documentation of primary-care in the paper record, The ARCH:"	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Don't Know
Is easy to use	3	3	1			
Increases completeness	6		1			
Reminds me to do things I might forget	6	1				
Improves overall quality of care	5	1		1		
Is well accepted by families	4	1	1			1
Improves quality of guidance	6		1			
Extends duration of RHCM visits	1	3	2		1	
Causes me to leave clinic later		3	1	1	2	
Reduces amount of eye-to-eye contact	2	3	2			
Should be recommended to other practices	6	1				

DISCUSSION

The delivery of comprehensive pediatric primary care services is complex and demanding. In this study, primary care delivered using an EMR was better in virtually every area evaluated including interim health history, risk assessment, developmental screening, physical examination documentation, and selected age-appropriate guidance topics. The most impressive improvement in quality was seen in the area of risk assessment, a finding that highlights a unique feature of EMRs. Users were prompted to ask about risk factors and could see by the template design that their answers would be available at the next visit—thus creating a longitudinal view of risk. In the paper-record, these items are frequently lost. We hypothesize that users were encouraged by both the importance of the question and prospect of future availability when deciding to record answers. In the two areas where quality measures in computer-based visits appeared to worsen (immunizations and PPD delivery), exogenous factors (an immunization outreach initiative and changes in recommendations) were different during the pre- and postintervention period.

The quality of anticipatory guidance also improved substantially. The EMR allowed users to discuss specific topics or print them in the English, Spanish, or French. These handouts (evaluated in a separate report) were well-accepted by families and improved their receipt of recommended guidance information. Clinicians are often overwhelmed by time limitations in the primary care setting. This EMR improved the completeness of delivery of age-appropriate guidance.

Potential adopters of pediatric primary care information technology are naturally worried about time demands involved in using an EMR. This study was not able to determine whether using the computer increased the duration of the visit because of an increase in documentation burden, decrease in documentation efficiency, or whether visits for these clinicians were longer because of prompting of clinicians to do things that might have been forgotten. The fact that nearly all users felt that the overall quality of care improved with its use and all users recommended use of the system by others suggests that the latter explanation is most likely. Another possible area of concern for potential adopters will be the effect of the EMR on the patient-physician relationship. Nearly all the users of the system felt that eye-to-eye contact with patients was reduced. Newer technologies such as wireless pen-tablets offer the potential to improve eye contact between clinicians and patients. However, it is likely that some physical adjustment in how physicians and patients relate will be necessary with an EMR.

Because of concerns about the quality of primary care services, there has been substantial interest in modifying physician behavior.¹⁴ In part, the evidence-based movement and quality improvement efforts reflect this concern. The Institute of Medicine, in its recent report entitled "Crossing the Quality Chasm," enumerated 5 aims for the US health care

system in the 21st Century including access to the medical knowledge-base, computer-aided decision support systems, collection and sharing of clinical information, reduction in errors, and enhanced patient and clinician communication. The report identified information technology, including the EMR, as the essential central component for reaching these aims.^{15,16}

The results of this study are limited in several ways. First, practice patterns may have changed because of factors other than exposure to the EMR. The use of a pre- postintervention study design was necessary because use of the system was voluntary, and there were insufficient users to perform a randomized trial. Berwick¹⁷ has suggested that research designs other than randomized trials will be necessary to assess quality improvement efforts. This is such a study, one that we believe represents important "real-time science." Importantly, clinicians agreed that prompts and reminders were effective. Furthermore, improvements in a number of areas were substantial and use of the EMR did not lead to a worsening of measures, which was also possible. A second limitation is that the study primarily assessed process measures. We cannot say whether asking previously overlooked questions leads to improved health outcomes. For example, although we were able to show that screening for smoking at home increased substantially, we could not determine whether identification of smokers ultimately leads to a reduction in smoking. Nonetheless, risk factors that remain undetected are unlikely to be addressed, and at a minimum, the EMR could serve as a resource for evaluating clinical effectiveness. Finally, this study used quality of documentation as a proxy for care delivered. Clinicians may have asked questions that were not documented. Videotaping clinicians during encounters was not possible and if done, would certainly have influenced physician behavior.

Our experience with this pediatric EMR suggests that EMRs can be successfully used in busy inner-city PPCCs and that appropriately designed systems will be accepted and can improve quality in many areas across the full-spectrum of pediatric primary care. Some might suggest that an EMR is just a sophisticated structured-encounter form. Clearly, much of the success of an EMR system can be attributed to its presentation of structured elements to enhance completeness. However, the EMR in this study offered more than prompting, including decision support (immunization status, calculation of growth percentiles, developmental milestone interpretation), longitudinal views of patient data, specialized growth charts, and improved access to laboratory and health care summary data. Although not evaluated in the study, some or all of these factors may have played a role in the ultimate acceptance of the EMR.

We believe that the pediatric EMR will become the central component of the pediatric primary care office of the future. We welcome the long-anticipated opportunities for population-based clinical care and improved preventive service quality offered by computer-enhanced pediatric primary care. Finally, we

agree with the Institute of Medicine that EMRs must play a central role in the redesign of the US health care system.

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LIFE WITHOUT GRANTS

"The pressure to get grants and renewals leads to lots of fraudulent data. . . A grantless scientist, like a landless peasant in the Middle Ages, may become something of a nonperson, excluded from key committees at his or her own university and from scientific panels in the field beyond. There was a flip side, however. Having no grants, not being on anyone else's grant-review committee, one could be said to be beholden to no one, and had no favors to receive or dispense. In the 'you-scratch-my-back-and-I'll-scratch-yours' commerce of higher academia he was an incorruptible loner. . . who could say what he thought."

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Submitted by Student

Use of an Electronic Medical Record Improves the Quality of Urban Pediatric Primary Care

William G. Adams, Adriana M. Mann and Howard Bauchner

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