

Improving Preventive Service Delivery Through Office Systems

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ABSTRACT. *Objective.* Rates of childhood immunizations and other preventive services are lower in many practices than national goals and providers' own estimates. Office systems have been used in adult settings to improve the delivery of preventive care, but their effectiveness in pediatric practices is unknown. This study was designed to determine whether a group of primary care practices in 1 community could implement office-based quality improvement systems that would significantly improve their delivery of childhood preventive services. The study was part of a larger community-wide intervention study reported in a preceding study.

Methods. All the major providers of primary care to children in 1 community were recruited and agreed to participate ($N = 8$ practices). Project staff worked onsite with improvement teams in each practice to develop tailored systems to assess and improve the delivery of immunizations and screening for anemia, tuberculosis, and lead exposure. Office-based quality improvement systems typically involved some combination of chart prescreening, risk assessment forms, Post-it prompts, flowsheets, reminder/recall systems, and patient education materials. Office systems also often involved redistributing responsibilities among office staff.

Results. All 8 participating practices created improvement teams. Project staff met with the practices 10 to 15 times over 12 months. After the period of office assistance, the overall rates for all preventive services except tuberculosis screening increased by amounts that were both clinically and statistically significant. Absolute percent improvements included: complete immunizations at 12 months, 7%; complete immunizations at 24 months, 12%; anemia screening, 30%; lead screening, 36%. The amount of improvement achieved varied considerably between practices.

Conclusions. Office systems and the principles of quality improvement that underlie them seem to be effective in improving the delivery of childhood preventive services. Important predisposing factors may exist within practices that affect the likelihood that an individual practice will make significant improvements. *Pediatrics* 2001;108(3). URL: <http://www.pediatrics.org/cgi/content/full/108/3/e41>; prevention, immunizations, improvement, office systems, primary care.

ABBREVIATIONS. TB, tuberculosis; HMO, health maintenance organization; RN, registered nurse; F/U, follow-up.

Preventive services are the cornerstone of pediatric primary care. The American Academy of Pediatrics, the American Academy of Family Physicians, and other national organizations recommend a complex array of anticipatory guidance, risk assessment, screening, and immunizations to prevent injury and disease in children.^{1,2} However, rates of most preventive services fall below national goals, and there is wide variation in these rates between practices. Deficits in immunization delivery have received most attention, but studies have found similar performance gaps for anemia, lead, tuberculosis (TB), and vision screening.^{1,3}

Many interventions have been developed to improve low rates of preventive services in practice settings; they can be categorized as patient oriented (eg, patient education), provider oriented (eg, audit and feedback), and practice oriented (eg, tracking systems). Much of the research on these interventions shows that any of them can have a positive effect on preventive service rates, but the effects are modest.^{4,5} Most studies, however, have examined the effects of only 1 or 2 interventions at a time. In addition, most have been conducted in academic rather than community practices.

Several recent studies have examined "office systems" designed to improve the delivery of preventive care.⁶ This approach breaks targeted services down into their component steps and focuses on improving processes involving the interactions of patients, staff, and providers to ensure that each step is performed on every eligible patient at every encounter. (Billing is an example of a service that virtually every practice has designed an office system to handle consistently.) In a randomized trial, Dietrich et al⁷ showed that primary care practices that implemented office-based quality improvement systems significantly improved their performance of mammography and clinical breast examinations. However, there have been no studies of office systems approaches in pediatric primary care settings. This reports a study that assessed the effectiveness of office-based quality improvement systems in a diverse group of primary care practices caring for children, as part of a larger study that examined the effectiveness of a multilevel intervention to improve child health and developmental outcomes in 1 community. Our hypotheses were that 1) office-based

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quality improvement systems would improve the rates of preventive care, and 2) there would be an added benefit to practices and the community from involving all the practices that cared for children in the community.

METHODS

Participants and Recruitment

We recruited all practices in Durham, North Carolina (population 182 000) that enrolled at least 5 newborns each month. Two family practice group practices, 3 pediatric group practices, the pediatric department of a large health maintenance organization (HMO), a university medical center, and a federally qualified community health center met this criterion. One of the investigators (C.B. or P.M.) met with 1 of the physicians (the senior member or other influential member) at each practice to describe the project and obtain consent to participate. We provided several incentives to the practices: 1) technical assistance in developing office systems; 2) continuing medical education credit for physicians who participated in the project; and 3) technical assistance with Medicaid billing to maximize practices' reimbursement for the preventive care they provided. The University of North Carolina's Committee on the Protection of the Rights of Human Subjects approved the study.

Interventions

In developing office-based quality improvement systems for prevention, we adapted the principles of continuous quality improvement,^{8,9} adult learning theory, and academic detailing.¹⁰ We systematically involved all levels of office staff (clerical, nursing, and providers) in reviewing performance data, identifying areas for improvement (ie, performance gaps), developing and implementing solutions, monitoring improvements, and revising interventions as needed. Project staff visited the practices often, both formally (eg, for meetings) and informally (eg, "drop-ins" and phone calls) to ensure that practice change moved forward.

We began the practice-based assistance by auditing a random sample of charts in each practice to measure baseline performance of immunizations and screening for anemia, lead poisoning, and tuberculosis. We then presented the results of the chart audits to the practices for review and discussion. At the end of this feedback session, each practice formed an improvement team called a "working group" that included clerical, nursing, and physician staff members. The group was responsible for more carefully analyzing the chart audit results, choosing the preventive services on which they wanted to focus, and setting 2 to 3 performance improvement goals.

The working groups developed office systems tailored to their priority areas. Most created systems that involved some combination of chart prescreening, provider reminders, preventive service flow sheets, patient education materials, and follow-up systems. The tools chosen depended on the working groups' analysis of which components of their office's delivery system needed improvement (Table 1).

Project staff facilitated working group meetings and provided technical support, including workflow analyses, evidenced-based recommendations for particular clinical services, graphic design assistance on new materials, and periodic chart reviews to assess change. Project staff also provided examples of flow sheets and patient education materials used by other practices or offered by professional organizations. These were then modified (eg, choosing specific ages at which to deliver each vaccine) and customized

(eg, adding a practice logo) to fit the practice's particular content needs and style. The working groups were responsible for obtaining input from relevant office staff on all new materials, and the materials were pilot tested and revised as needed.

In addition to new tools, the office systems commonly involved the redistribution of responsibilities among office staff. Once detailed plans to implement changes were developed, project staff assisted in systematic training of practice staff regarding these new systems. Any problems encountered by office staff with their systems were referred to the working group. Project staff supported this process by monitoring change and assisting working groups to revise materials.

Office System Tools

Patient-level tools put in place included patient activation cards and age-specific patient education materials. Patient activation cards prompted parents to ask their provider age-appropriate questions about their child's preventive care. For example, in 1 practice, laminated cards indicating the immunization schedule were given to parents to review while waiting to be seen. The cards encouraged parents to ask their doctor if they had any doubt about whether their child was fully immunized. The cards also served as visual prompts to physicians when they observed parents reviewing the cards. Patient education materials focusing on preventive care were systematically provided to families. For example, 1 practice developed anticipatory guidance packages on age-appropriate injury prevention tailored to their schedule of well-child visits. The patient level materials used were developed with input from families as part of an earlier pilot project.

Provider level tools included provider reminders (eg, Post-it prompts placed on charts prescreened by registered nurses [RNs]) and risk assessment tools (ie, materials developed to systematically assess disease-specific risks that would dictate the need for more screening). The tools varied in their content, as did the mechanisms developed to ensure their completion (eg, self administered by parents or incorporated into the RN assessment). The most commonly used risk assessment materials assessed risk for TB and lead exposure.

Practice level tools included chart screening, flow sheets, enhanced well-child visit forms and tracking systems. Chart screening was defined as a system by which someone other than the provider systematically reviewed a patient's chart before the patient was seen. The screening was linked to using Post-its in most practices, so that after screening a visual prompt was placed on the chart of a child due for services (eg, "immunizations due"). We encouraged practices to use these systems for all patient visits, but especially for non-well-child visits, where missed opportunities are most common.¹¹ Flow sheets included tables or charts that listed age-specific preventive services indicated. The charts served as either a simple template of the practice's preventive service schedule, or as a grid where services provided were documented. Enhanced well-child visit forms incorporated prompts for specific screening and counseling activities into preprinted, age-specific encounter forms. The forms were formatted to both prompt providers and simplify and clarify the recording of services provided. Tracking systems included mechanisms to identify children who had not come in to the practice recently and/or who were not up to date on preventive care. Implementation of this intervention, more than any of the others, depended on the sophistication of the practice's computer system. Project staff spent a considerable amount of time helping practices assess the querying capacity of their practice management programs.

Process Measures

We used surveys to collect descriptive information about the practices from clinical and nonclinical staff and the business manager. Variables measured included the number of providers, nurses and nonclinical staff, patient volume, newborns seen per month, insurance mix, scheduling mechanisms, follow-up systems, after-hours availability, computer resources, and screening methods currently in use.

Offices were free to choose the preventive services on which they wanted to work, and the 8 practices developed office systems tailored to their unique circumstances. Project staff monitored the implementation of each office's system using structured observations, chart reviews, and informal "drop-in" visits. Once implemented, project staff assessed the extent to which new systems or

TABLE 1. Potential Elements of Office Systems

Process Needing Improvement	Possible Tool
Identifying service needs	Flow sheet
Prompting providers	Post-its
Educating patients	Patient activation materials
Documenting services	Flow sheet
Simplifying chart screening	Flow sheet
Following-up	Tracking system
Monitoring effectiveness	Chart reviews

tools were actually used to determine 1) the proportion of eligible patient visits to which the systems were applied, 2) the accuracy of the screening and prompting systems, and 3) the proportion of children brought up to date as a result of office system activities. These data were fed back to the working groups. When problems were identified, the groups were encouraged to make the necessary modifications.

Outcome Measures

The primary outcomes were the proportions of children up-to-date on immunizations at 12, 19, and 24 months and the proportions screened for anemia, TB, and lead exposure. Immunization status was determined based on all vaccines recorded in the practice charts. For children noted to be underimmunized, we searched the records at the local health department for evidence of additional immunizations. Any record of a hematocrit or complete blood count found in the chart between ages 6 months and 18 months was considered evidence of anemia screening, even if the test was performed as part of the evaluation of a febrile or other illness. Evidence of either risk assessment or formal testing (ie, skin test or blood lead level) before 24 months old was considered sufficient for TB and lead screening.

The proportion of children up to date with preventive services at baseline was determined by auditing approximately 40 randomly selected charts of 24 to 36-month-old patients in each practice ($N = 339$). Follow-up proportions were determined by auditing a second random sample of charts approximately 12 months after each office's systems were operational. In each practice, approximately 35 charts were selected from each of 3 age strata: 12 to 18 months, 19 to 24 months, and 25 to 30 months. This was done to have sufficiently large samples of children of different ages to examine the relationship between the duration of exposure to new preventive services systems and any increase in rates of services that might take place (statistical analysis section).

Trained research assistants abstracted practice charts using methods described previously.³ Data were entered directly into laptop computers using software developed specifically for the project. A 10% sample of charts was double audited to assess interrater reliability. Percent agreement ranged from 0.75 to 1.0 on key outcome measures. As a final data quality check, the charts of all children found to be underimmunized were carefully reviewed by one of the physician investigators. This process decreased misclassification of outcomes attributable to data entry errors. It also increased the credibility of findings presented to the practices and provided insight into how practices were failing to appropriately immunize children (eg, missed opportunities, losses to follow-up, etc.).

Statistical Analysis

The statistical analysis was designed to test the hypothesis that the mean proportion of children with age-appropriate preventive services across all practices would improve after the office-based quality improvement systems were implemented. As noted above, before the start of the intervention, baseline proportions for all preventive services were estimated based on a sample of charts for patients 24 to 36 months old. Approximately 1 year after each office implemented its new systems, new randomly selected samples of charts were abstracted for children ages: 12 to 18 months (follow-up [F/U] sample 1), 19 to 23 months (F/U sample 2), and

24 to 30 months (F/U sample 3). Three separate age groups were sampled so that we could assess the effect of different durations of "exposure" to the intervention.

We posited that F/U sample 1 infants (eg, age 0–7 months at the beginning of the intervention) would be seen in the practices more frequently and should, therefore, have more "exposure" to an office's new system for care delivery than older children in F/U sample 3 (who were age 12–18 months at the beginning of the intervention) who might have visited their practice less frequently during the intervention period. Thus, infants in F/U sample 1 had between 5 and 12 months exposure before the 12-month immunization outcome measurement but were not old enough to be included in the 24-month immunization outcome measurement. Similarly, children in F/U sample 3 had 6 to 12 months exposure before the 24-month immunization outcome, but because they were already at least 12 months old at the beginning of the intervention, they had no exposure to the intervention relevant to the 12-month immunization outcome.

Three methods were used to test the hypothesis that preventive service rates would improve after the office systems were implemented. First, Mantel-Haenzel χ^2 tests controlling for practice were used to compare overall proportions in the baseline and follow-up samples. The Van Elteren extension to the Mantel-Haenzel χ^2 was used for tests of trend. Second, to assess the effect of exposure more sensitively, the probability of receiving each preventive service was modeled as a function of the duration of exposure (in months). Exposure was computed as the difference in months between the age at which the outcome was assessed and the child's age at the onset of the intervention. To account for the clustering of patients within practices, logistic models were fit using the method of generalized estimating equations¹² assuming an exchangeable correlation structure. Wald tests were used to examine the significance of the exposure effect.

After the 1989 to 1991 measles epidemic, North Carolina, like many states, put a great deal of emphasis on improving immunization rates, and state-wide immunization rates have improved.¹³ Therefore, as a third test of the intervention's effectiveness, we assessed the possibility that secular trends accounted for improvements in rates of preventive services. To do so, we compared the postintervention preventive service rates in the study practices with baseline estimates from a second group of randomly selected North Carolina private primary care practices that were taking part concurrently in an unrelated trial. Because academic practices and community health centers were excluded from this trial, this comparison was limited to the 6 private practices in the Durham group. Tests comparing these 2 groups of practices were based on Wald χ^2 tests derived from generalized estimating equation logistic models.

RESULTS

All 8 practices invited agreed to take part in the project, including both pediatric and family practices. The practices varied considerably in size and organization (Table 2). The 2 family practices saw fewer children than the pediatric practices. The university pediatric practice was the largest by virtue of the large number of faculty physicians in their prac-

TABLE 2. Characteristics of Participating Practices

Characteristic	Practice							
	1	2	3	4	5	6	7	8
Type								
Specialty	Ped	Ped	Ped	Ped	Ped	FP	FP	Ped
Organization	Group	CHC	Group	Univ	Group	Group	Group	HMO
Staff Size								
Clinicians*	7	7	8	12	6	11	6	8
RN/LPN	5	7	10	12	7	5	10	6
Administrative	7	7	6	14	7	9	6	3
Percent Medicaid	10	80	4	40	<5	4	5	NA

Ped indicates pediatrician; FP, family practitioner; CHC, community health center; Univ, university; NA, not applicable.

* Total number of clinicians employed by the practice.

tice. The university's resident continuity clinic was not included in the study. The community health center was the most administratively complex. The pediatric clinic within the HMO was the only unit of that organization that participated.

Process Outcomes

All 8 practices created working groups. Project staff met with the practices an average of 10 to 15 times over the course of the project. The number of tools and the overall complexity of new systems developed in the practices varied considerably (Table 3). The most administratively complex practice chose only to implement enhanced well-child visit forms. In contrast, 1 practice implemented new preventive service flow sheets, age-specific patient education materials, enhanced well-child visit forms, a system by which nurses prescreened charts and did risk assessments and counseling with families before the physician entered the examination room, Post-it physician reminders, and a tracking system that identified 19-month-olds who had not been in for their 18-month well-child visit.

Although 7 of the 8 practices developed new or improved existing tracking systems, the systems varied in complexity. The HMO already had access to a sophisticated regional immunization tracking system. This practice chose to work on ways of improving the accuracy of immunization data by ensuring that new and historical data were entered into the system in a timely manner. One pediatric group practice developed a card file system to determine when patients turned 19 months, at which time a child's chart was pulled and reviewed. Parents of children noted to be behind on preventive services were sent a postcard encouraging them to call for an appointment.

Preventive Service Outcomes

Baseline rates for 12- and 24-month immunization coverage and for anemia, lead and TB screening are shown in Fig 1. There was substantial variation in all rates, with the greatest seen in TB screening. After the period of office assistance, the mean proportion of children with age-appropriate preventive services across all practices increased for all services except TB screening. Increases were both clinically and sta-

tistically significant, ranging from a 7% absolute change in 12-month immunization coverage to a 36% change in anemia screening (Table 4).

For immunizations at 12 and 19 months and anemia screening, the proportion of children up-to-date increased with increasing exposure to the intervention (ie, F/U sample 1 > F/U sample 2 > F/U sample 3; Table 4). For each outcome, tests for linear trend with increasing exposure were statistically significant ($P = .001$). The observation that the proportions of children up-to-date for immunizations at 12 months in the baseline and F/U Sample 3 (where exposure was 0) did not differ significantly supports the inference that the improvements observed in F/U samples 1 and 2 were attributable to the intervention rather than to a secular trend.

Figures 2 to 5 show the changes in individual practice rates. Although all aggregate rates improved, the 8 practices did not all achieve similar improvements. For example, the change in the proportion of 24-month old children completely immunized ranged from -21% to +46% (Fig 2). Four practices improved their TB screening rates, whereas 3 were worse after the intervention and 1 was essentially unchanged (Fig 4). All the practices improved their rates of screening for lead poisoning.

Practices' likelihood of improving particular rates were related to 1) their decisions about whether to target a particular service (eg, lead screening), and 2) their overall ability to develop and implement new systems. For example, all practices chose to focus on improving immunization rates, and all but 1 improved in this area. In the 1 practice that saw a decline in the rate, the working group was hampered by frequent staff turnover and long periods of inactivity between group meetings. Thus, they were unable to successfully implement new approaches to immunization delivery. Three practices (numbers 4, 5, and 6) chose to focus on increasing TB screening. All 3 achieved substantial improvements (Fig 4). The other 5 practices did not choose to address TB screening, and their rates remained essentially unchanged.

National and state surveillance data indicate that immunization rates across North Carolina increased during the period of this study. As noted earlier, to see if the improvements measured in these practices between 1995 and 1998 simply represented secular improvements, we compared the postintervention 24 month immunization rates in the Durham practices measured in 1998 to rates measured in 16 randomly selected NC practices taking part in an unrelated study, also measured in 1998. The 24-month coverage rate in these 16 practices (which did not include university or community health centers) was 78%. The postintervention rate in the Durham practices was higher (85% vs 78%, $P = .17$), although the difference was not statistically significant.

DISCUSSION

We found that implementing office-based quality improvement systems to improve the delivery of preventive services seems to be both feasible and effective. Both pediatric and family practices agreed to participate. Overall rates of immunization cover-

TABLE 3. Frequency of Use of Various Office Tools in the 8 Study Practices

Office System Tools	Number of Practices Using Tool
Patient level	
Activation cards	2
Age-specific education packets	3 (1)
Provider level	
Post-it prompts	8
Risk assessment forms	6
Practice level	
Chart prescreening	6
Flow sheets	6
Tracking systems	5 (2)
Enhanced physical exam forms	3

Numbers in parentheses represent practices that already had these systems in place before intervention.

Fig. 1. Baseline rates of preventive services.

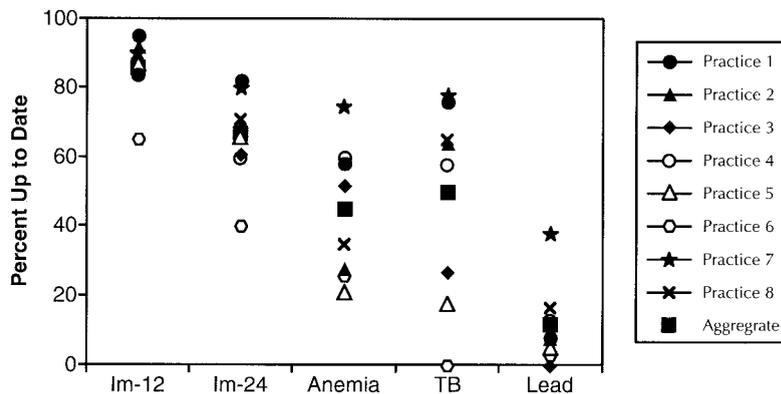


TABLE 4. Mean Changes in Proportion of Children Receiving Preventive Services From Baseline Across All Practices

Sample Age at Follow-Up	Age at Start of Intervention	12-Month Immunization (%)	19-Month Immunization (%)	24-Month Immunization (%)	Anemia (%)	Lead (%)	TB (%)
Baseline 24-36 mo (N = 339)	—	86	46	67	45	12	50
Follow-up Sample 3 24-30 mo (N = 300)	12-28 mo	89	68	79**	67**	48**	52
Sample 2 19-23 mo (N = 285)	7-12 mo	93*	73	NA	75**	NA	NA
Sample 1 12-19 mo (N = 289)	0-7 mo	93*	NA	NA	NA	NA	NA

Immunization 12: DTP × 3, OPV/IPV × 2, Hib × ≥2.

Immunization 19 and Immunization 24: DTP × 4, OPV/IPV × 3, MMR, Hib × ≥3 (with 1 Hib given at ≥11.5 months).

Anemia: Hematocrit or hemoglobin between 6 and 18 months

Tuberculosis: Risk assessment or skin testing prior to age 24 months

Lead screening: Risk assessment or blood lead level (BLL) prior to age 24 months

* P = .01 compared to baseline group.

** P = .001 compared to baseline group.

NA not applicable because children in the sampled age range were younger than the cutoff for the outcome.

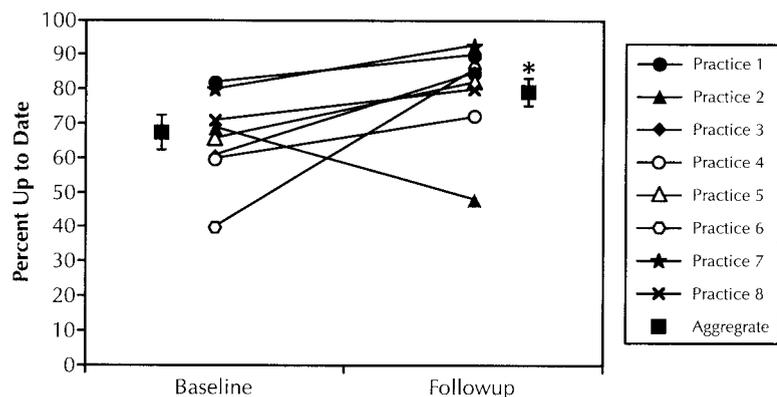


Fig 2. Percentage of children fully immunized at 24 months of age

age and rates of screening for anemia and lead exposure improved. However, the number and types of tools implemented and the rates of improvement varied considerably between practices. This variation reflected the practices' chosen goals and their degree of engagement in the improvement process.

To accommodate the constraints of making change in a busy office, most practices implemented new office systems gradually. For example, most of the practices implementing a preventive services sum-

mary sheet used paper-based record systems. Implementing this tool requires identifying the dates of preventive services from the medical record and completing the summary sheet with the dates that services took place. Such a tool is simpler to implement for children joining the practice as a newborn because no "backfilling" of the form is required. Thus, newborns at the time of implementation were more likely to be exposed than older children. In addition, the frequency with which children seek

Fig 3. Percentage of children screened for anemia by 24 months of age.

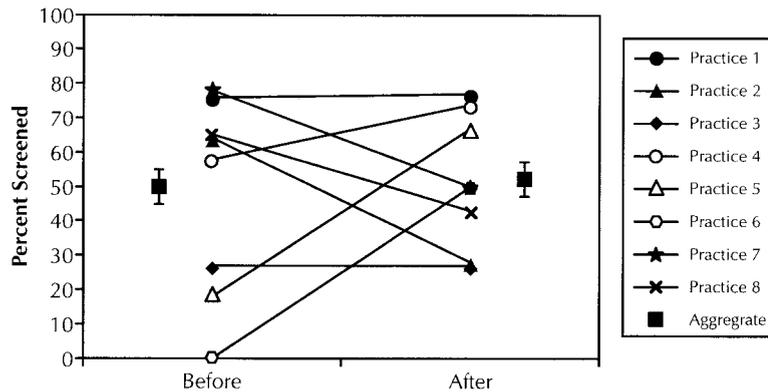
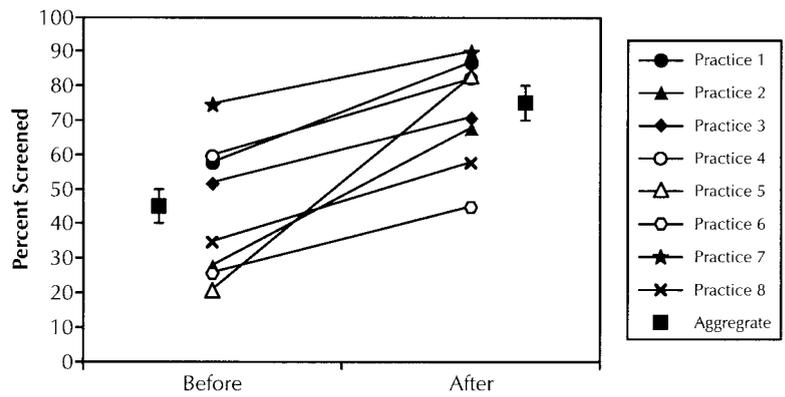
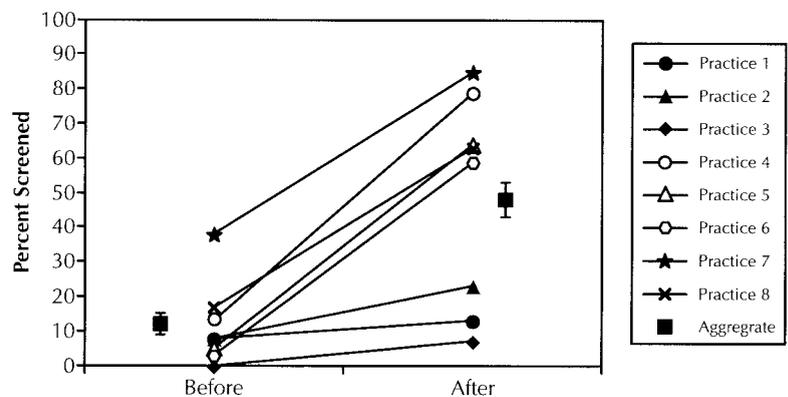


Fig 4. Percentage of children screened for TB by 24 months of age.

Fig 5. Percentage of children screened for lead exposure by 24 months of age.



preventive services decreases as children age. Therefore, children in the second year of life would be less likely to be exposed to any changes simply because they would be less likely to be seen. We examined the effect of duration of “exposure” to the offices’ new systems to account for: 1) differing age cutoffs for the various outcome measures, 2) differences in the frequency with which children at different ages used practices for preventive services, and 3) the practical aspects of preventive service system implementation.

Our study had several limitations. First, the improvements we observed may have reflected improved chart documentation rather than increases in the delivery of services. Nevertheless, we would consider improved charting a successful outcome of the intervention. Clinicians are unlikely to comb charts for missing data during a busy clinical day. Thus, it is in patients’ best interest for their charts to be well

organized. This facilitates efficient care, makes screening for needed services easier, prevents unnecessary repeated services (eg, overimmunization), and improves communication between providers within a practice.

Second, although we demonstrated clinically and statistically significant improvements in most preventive services at the practice level, the number of practices enrolled was small. Future studies of office-based quality improvement systems will need to include larger numbers of practices to determine if our results are generalizable and to see if there are practice characteristics that are associated with improvement. In this study, it was clear to project staff that the administrative complexity and lack of organizational cohesiveness in one practice played a major role in the inability of its working group to effect change. This and other observations helped us recognize that practice organizational factors (not measured

in this study) are likely to be strongly associated with successful implementation of office systems. Future studies should attempt to define these predisposing characteristics of primary care practices.

Despite these limitations, we believe that office systems and the principles of quality improvement that underlie them are potentially powerful tools for increasing rates of preventive services. Although numerous individual interventions have been shown to improve the delivery of preventive services, their effect sizes are generally modest. Oxman et al⁵ reviewed 102 trials of interventions designed to improve health professionals' performance and concluded that there are no "magic bullets." Rather, a variety of interventions, used appropriately, may lead to important improvements in professional practice and patient outcomes.

In pediatrics, much research has focused on improving immunization delivery, but far less has examined other preventive services. The National Vaccine Advisory Committee, in the Standards for Pediatric Immunization Practices, recommended that practices operate tracking systems and conduct semiannual audits.¹⁴ The Task Force on Community Preventive Services, along with staff from the Centers for Disease Control and Prevention's National Immunization Program, reviewed 118 studies of 17 interventions to improve immunization delivery,¹⁵ 6 of which were practice-based (reminder/recall systems, multicomponent interventions that included education, clinic-based education only, provider reminder/recall, assessment and feedback for vaccination providers, standing orders). Based on the evidence from these reviews, 5 of the 6 interventions are "recommended" or "strongly recommended." However, from a practice's perspective, implementing reminder/recall, assessment and feedback, or any of the other interventions supported by the literature requires significant effort. Many practices lack the resources or motivation needed to develop new office-based quality improvement systems for a single clinical issue (eg, immunizations). In this study, we avoided the single intervention, single outcome approach, reasoning that new office systems developed to improve immunization delivery could also be used to improve the delivery of other preventive services.

In addition to focusing on the performance of individual practices, we hoped to demonstrate that a program involving all the providers in a single community could improve preventive care delivery to all children in the community. Unfortunately, population-based rates for immunizations or other preventive services were not available in Durham, North Carolina, to follow over the course of the intervention. We did, however, find that practices appreciated the fact that their peers were involved in parallel efforts. The practices met twice during the course of the study to share successes, failures and improvement strategies. Similar to our practice-based approach, Sinn et al¹⁶ used a practice-based physician leadership approach and targeted an entire community. Combining semiannual chart audits with training in continuous improvement in 10 practices, they

were able to demonstrate a 19% increase in up-to-date coverage at 24 months. They did not report changes in population-based results for their community, but like us, these authors found that their efforts had additional benefits. Practices were interested in applying improvement principles to services other than immunizations. The activities of the practices attracted the interest of several larger health systems, managed care organizations, and the state Medicaid program. Similarly, several of the practices in our study have moved on to participate in a collaborative community-based effort to improve asthma care.

We found that most of the practices in our study initially had no formal understanding of quality improvement. Our findings suggest that implementing office systems and applying principles of improvement in primary care settings is effective. However, before recommending their widespread adoption, they must be subjected to additional study using a controlled experimental design. Furthermore, we do not know if the improvements achieved by the practices in our study are sustainable. Finally, the methods we used were labor intensive. We are currently working with 44 practices in a randomized trial to address some of these issues. It is our hope that by studying larger numbers of practices, we can identify the practice and intervention characteristics that are most strongly associated with clinically meaningful improvements. If this approach is to be feasible on a large scale, it will be important to determine what types of practices are likely to benefit from the approach and to examine the level of assistance that practices need to make and sustain significant improvements.

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