Effect of Open Access Scheduling on Missed Appointments, Immunizations, and Continuity of Care for Infant Well-Child Care Visits

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Objective: To examine the effect of open access scheduling (OA) on infant well-child care (WCC).

Design: Cluster randomization of 2 methods of OA compared with a baseline group (prior to OA).


Participants: Ten providers (pediatricians and physician assistants) and 878 infants; 2-, 4-, and 6-month WCC visits were scheduled.

Interventions: Two scheduling methods were compared under the OA model: the OA future visit group scheduled their infant’s next WCC visit when leaving the visit, and the OA same day group called for a same-day appointment.

Main Outcome Measures: Missed appointment rates, on-time immunization rates, and continuity of care.

Results: Missed appointment rates decreased from 21% in the baseline group to 14% and 9% in the OA future visit and OA same day groups, respectively (P<.02). For 630 infants older than 5 months at study end, on-time immunization rates were 59% in the baseline group and 74% in both OA groups (P<.006). Of 412 infants with 2 or more WCC visits, 75% in the OA future visit group and 60% in the OA same day group saw the same provider for all visits (P=0.001). This difference was due to differences among providers, not to the different scheduling methods.

Conclusion: Open access scheduling decreases missed appointments for infant WCC visits and appears to increase on-time immunizations.

Arch Pediatr Adolesc Med. 2006;160:889-893
for an appointment in OA, immunization rates might decrease. We found no published data on the effect of OA on immunization rates or whether it is better to schedule infant WCC visits in advance compared with same-day scheduling.

The hypotheses for this project include: (1) The missed appointment rate for WCC visits will be reduced from the estimated baseline (non-OA) rate of 25% to 16% in OA. (2) There will be no difference in on-time immunizations in the baseline group compared with the OA group.

STUDY SETTING AND POPULATION

This study was conducted in a pediatric clinic of a community health center, Westside Family Health Center (WFHC), that is part of Denver Health, an integrated health system. The system includes a safety-net hospital, 9 community health centers, and other entities. The WFHC clinic is staffed by pediatricians, physician assistants, residents, and support staff. More than 25,000 immunizations are administered annually at approximately 25,000 visits. About two thirds of the patients have Medicaid, one third are uninsured, and less than 5% have commercial insurance. The patients are largely of Mexican origin. Prior to the start of OA in October 2003, all infants were scheduled for the next 2-, 4-, or 6-month WCC visit at the end of the prior visit.

BASELINE PERIOD

For the 2 months preceding the change to OA, missed appointments and immunizations were tracked for all infants scheduled for 2-, 4-, and 6-month WCC visits.

OPEN ACCESS PERIOD

Ten pediatricians and physician assistants caring for infants were divided into 4 groups of 2 or 4 providers each by sessions worked throughout the study period were excluded. Half of each group was randomized (by cluster) to the OA future visit group. Families needing a 2-, 4-, or 6-month WCC visit prescheduled their next appointment (same scheduling system as during baseline). The other half was randomized to the OA same day group, whose families called for an appointment the week it was needed. Informed consent was obtained from all providers.

The clinic began OA for all patients on October 1, 2003. Beginning at the 2-week WCC visit, providers in the OA future visit group gave parents an appointment slip for the clerk to schedule their next appointment prior to leaving the clinic. Providers in the OA same day group gave parents a reminder slip with their pediatrician’s or physician assistant’s name and the proper week to call for their infant’s next appointment. Under OA, 50% to 75% of appointments were available at the beginning of each day.

Standard procedures for infant WCC visits included the following:

- Standardized forms were used to document WCC visits.
- At all clinic visits, the Denver Health immunization registry was queried. Immunization history and recommended immunizations were printed for the provider to review.
- The immunization registry printed recall postcards that were mailed monthly when infants were more than 30 days overdue for immunizations. Mailings were repeated every 3 months until the appropriate immunizations were recorded or the infant was inactivated from the registry.
- When infants did not attend a WCC visit, the medical assistant made a telephone call or sent a postcard to remind parents to reschedule.
- Standard immunizations for infants during the study included the administration of combined diphtheria and tetanus toxoids and acellular pertussis–inactivated poliovirus–hepatitis B vaccine, H influenzae type b vaccine, and 7-valent pneumococcal conjugate vaccine at 2-, 4-, and 6-month WCC visits.

DATA COLLECTION

Data were collected for all infants attending 2-, 4-, and 6-month WCC visits from August through September 2003 (baseline) and during the first 4 months of OA from October 1, 2003, through January 31, 2004 (Figure). All data were collected from computerized information systems. The clerks scheduling appointments noted which infants were scheduled for 2-, 4-, or 6-month WCC visits. On a biweekly basis during the study, 1 research assistant searched the daily schedule for each study provider. For any patient having a 2-, 4-, or 6-month WCC appointment, the medical record number, patient name, provider name, visit date, the appointment was scheduled, and appointment attendance were recorded in a spreadsheet. The date of birth, sex, insurance, and race/ethnicity (by parental report) were collected from registration data. The immunization registry was checked for immunizations administered. Data were generally collected within 2 weeks of the visit date.

Any infant who had a 2-, 4-, or 6-month WCC visit scheduled with 1 of the study providers during the study period was included. Infants completed the study when they received their 6-month immunizations or on January 31, 2004, whichever came first. After January 31, 2004, the immunization registry was queried on all children whose immunizations were not up-to-date. Immunizations given at nonstudy visits or given elsewhere were included in the data collection and analysis. At the end of data collection, the patient name and hospital number were removed to deidentify the data.

DATA ANALYSIS

Statistical analysis was performed using SPSS for Windows version 12.0 (SPSS Inc, Chicago, Ill) and SAS version 8.2 (SAS Institute Inc, Cary, NC).14 Categorical variables were compared by χ² test, and nonnormally distributed continuous variables were compared by Kruskal-Wallis test.

Ethnic group was reported by families as Hispanic; however, it was transformed into Mexican American based on prior research at WFHC. Providers were identified as being fluent in Spanish or not. Insurance was dichotomized into having any insurance (Medicaid, State Children’s Health Insurance Program, or private insurance) vs self-pay or being a Medicaid applicant. When insurance was used as a variable in the regres-
sion models for analysis of immunization rates and continuity of care, the insurance status at the last appointment was used.

Three outcomes were analyzed. The missed appointment status was tabulated for each scheduled visit. Repeated logistic regression was used to examine the effect of the risk variables, group (baseline, OA future visit, and OA same day), insurance status, and Spanish-speaking provider on the missed appointment status. Correlation due to the repeated measurements on the same subjects (possible 2-, 4-, and 6-month visits) was taken into account during modeling.19

On-time immunization rates based on all immunizations in the registry assessed the proportion of infants older than 153 days (5 months) at study completion who had received their most recent immunizations within 30 days of the recommended age for that immunization. The Luman definition of being younger than 153 days for the receipt of 4-month immunizations or younger than 214 days for the receipt of 6-month immunizations was used.20 Infants were coded as being in the baseline, OA future visit, or OA same day group by the group they were in for the last study visit. Logistic regression was used to examine the effect of the risk variables, group (baseline, OA future visit, and OA same day), insurance status, and Spanish-speaking provider on the on-time immunization rate.

Continuity of care was assessed for all infants having 2 or more visits during the study. Infants were coded as having perfect continuity (being seen by the same provider for all visits) or not (being seen by >1 provider). For the comparison of rates of perfect continuity between the 2 OA groups, the match effect for provider and cluster effect for patients nested within providers were taken into consideration during modeling. Logit link function and binomial distribution were applied to the outcome variable in the nonlinear effect model.

The project was approved by the Colorado Multiple Institutional Review Board and a Health Insurance Portability and Accountability Act of 1996 waiver was obtained.

### RESULTS

Between August 1, 2003, and January 31, 2004, 1563 appointments for 2-, 4-, or 6-month Well-Child Care (WCC) visits were scheduled for or attended by 878 infants. Table 1 compares the demographic information of the infants and the Spanish fluency of the providers among the 3 groups.

The 2 different methods of OA used in this study resulted in significant differences among the baseline and the 2 OA groups for the median number of days ahead that the appointments were scheduled and the number of appointments scheduled the same day and within 36 hours of the appointment. There were 228 missed appointments (15%). The missed appointment rate decreased by 30% in the OA future visit group and by more than 50% in the OA same day group (Table 2). Variables associated with the decreased missed appointment rate for 1539 visits included being in the OA future visit group vs the baseline group (adjusted odds ratio [OR], 0.58 [95% confidence interval (CI), 0.42-0.80]), being in the OA same day group vs the baseline group (adjusted OR, 0.38 [95% CI, 0.26-0.53]), being seen by a Spanish-speaking provider (adjusted OR, 0.58 [95% CI, 0.43-0.79]), and having insurance (adjusted OR, 0.57 [95% CI, 0.40-0.82]).

Of the 630 infants who were older than 5 months at study end, 59% of the baseline group and 74% of both OA groups had on-time immunizations (Table 2). Variables associated with on-time immunizations for 628 infants included being in the OA future visit group vs the baseline group (adjusted OR, 2.12 [95% CI, 1.34-3.36]), being in the OA same day group vs the baseline group (adjusted OR, 2.12 [95% CI, 1.34-3.36]), and having insurance (adjusted OR, 0.57 [95% CI, 0.40-0.82]).

### Table 1. Comparison of Demographic Factors and Visit Characteristics During Baseline and OA Periods for 1563 Appointments

<table>
<thead>
<tr>
<th>Demographic Factor</th>
<th>Baseline (n = 483)</th>
<th>OA Future Visit (n = 522)</th>
<th>OA Same Day (n = 558)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>235/483 (49)</td>
<td>275/522 (53)</td>
<td>280/558 (50)</td>
</tr>
<tr>
<td>Has Medicaid/insurance</td>
<td>399/483 (83)</td>
<td>443/519 (85)</td>
<td>460/553 (83)</td>
</tr>
<tr>
<td>Mexican American</td>
<td>452/479 (94)</td>
<td>466/511 (91)</td>
<td>532/553 (96)*</td>
</tr>
<tr>
<td>WCC visit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 mo</td>
<td>183/483 (38)</td>
<td>198/522 (38)</td>
<td>202/558 (36)</td>
</tr>
<tr>
<td>4 mo</td>
<td>178/473 (37)</td>
<td>179/522 (34)</td>
<td>192/558 (35)</td>
</tr>
<tr>
<td>6 mo</td>
<td>122/483 (25)</td>
<td>145/522 (28)</td>
<td>164/558 (29)</td>
</tr>
<tr>
<td>Seen by Spanish-fluent pediatrician/physician assistant</td>
<td>311/483 (64)</td>
<td>279/522 (53)</td>
<td>418/558 (75)</td>
</tr>
</tbody>
</table>

Abbreviations: OA, open access scheduling; WCC, well-child care.

†P < .001 by χ² test, with the significant difference being between OA future visit and OA same-day groups.

‡P < .001 by χ² test, with each group being significantly different from the other 2 groups.

TABLE 2. Comparison of Outcome Variables and Characteristics of Appointment Scheduling During Baseline and OA

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>Baseline</th>
<th>OA Future Visit</th>
<th>OA Same Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of days ahead appointment was scheduled, median (n = 1563)</td>
<td>48</td>
<td>15</td>
<td>0†</td>
</tr>
<tr>
<td>No. of appointments scheduled same day or day before (n = 1563)</td>
<td>10/483 (2)</td>
<td>176/522 (34)</td>
<td>398/558 (71)‡</td>
</tr>
<tr>
<td>No. of appointments scheduled same day (n = 1563)</td>
<td>6/483 (1)</td>
<td>126/522 (24)</td>
<td>279/558 (50)‡</td>
</tr>
<tr>
<td>Missed appointment rate (n = 1563)</td>
<td>101/483 (21)</td>
<td>74/522 (14)</td>
<td>53/558 (9)§</td>
</tr>
<tr>
<td>On-time immunization rate (n = 630)</td>
<td>94/158 (59)</td>
<td>161/218 (74)</td>
<td>187/254 (74)</td>
</tr>
<tr>
<td>Perfect continuity of care (n = 412)</td>
<td>NA</td>
<td>135/180 (75)</td>
<td>138/232 (60)¶</td>
</tr>
</tbody>
</table>

Abbreviations: NA, not applicable; OA, open access scheduling.

*Data so given unless otherwise indicated.

†P < .001 by Kruskal-Wallis test, with each group being significantly different from the other 2 groups.

‡P < .01 by χ² test, with each group being significantly different from the other 2 groups.

§P < .02 by χ² test, with each group being significantly different from the other 2 groups.

¶P < .006 by χ² test, with the baseline group being significantly different from the 2 OA groups.

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group (adjusted OR, 1.89 [95% CI, 1.22-2.93]), having insurance (adjusted OR, 2.95 [95% CI, 1.68-5.19]), and being seen by a Spanish-speaking provider (adjusted OR, 1.55 [95% CI, 1.06-2.26]).

Of the 412 infants having 2 or more WCC visits, 274 (67%) had perfect continuity. In the OA future visit group, 136 (75%) of 180 infants had perfect continuity compared with 138 (60%) of 232 infants in the OA same day group ($P = .001$). This difference in perfect continuity was not due to the difference between the OA methods ($P = .90$) but was due to variation among the providers.

**COMMENT**

Use of OA decreased missed appointment rates for WCC visits from 21% in the baseline period to 14% in the OA future visit group and to 9% in the OA same day group. The decrease in the missed appointment rate in the OA future visit group was unexpected. The OA future visit group had a significant increase in appointments scheduled within 36 hours of the visit compared with the baseline period (Table 2). Only 50 (8%) of the 584 appointments scheduled within 36 hours of the visit were missed, compared with 177 (18%) of 978 missed appointments scheduled more than 1 day in advance. Scheduling appointments within 36 hours of the visit was associated with decreased missed appointments.

High missed appointment rates affect patient flow, the availability of appointments, and productivity. Missed appointment rates of 8% to more than 50% have been found in patients insured by Medicaid.9,22-25 Belardi et al4 did not find a decrease in missed appointment rates after implementation of OA in a family practice clinic; however, their baseline missed appointment rate of 9% was much less than the baseline missed appointment rate of 21% for infants at WFHC. Bundy et al8 found that missed appointment rates decreased from 16% to 11% in 4 pediatric and family practice clinics after the introduction of OA. With the decreased missed appointment rate at WFHC, we have decreased the number of appointments scheduled and increased the number of patients seen in a session. This increases access to care.

Three factors were associated with decreased missed appointment rates: being in either of the OA groups, being seen by a Spanish-speaking provider (a proxy for our patients who are monolingual Spanish speakers), and having insurance. Monolingual Spanish-speaking families at WFHC are recent immigrants from Mexico and their infants, born in the United States, are eligible for Medicaid. Having health insurance is a marker of their ability to complete the Medicaid paperwork. Inability to complete the Medicaid paperwork may be associated with other problems in accessing care. Families without Medicaid may not have attended a visit for fear of getting a bill.

On-time immunizations improved by 25% between the baseline group and the OA groups. The decrease in missed appointment rates in the OA groups should increase immunization rates. Trigooyen et al found that children who attended their appointment after a reminder call were 2.3 times more likely to be up-to-date on immunizations than children who missed the visit. LeBaron et al improved immunization rates by 3% to 6% by using an automated appointment reminder/recall system; however, the major reason for delayed immunizations remained missed appointments. In OA, if an appointment is canceled or missed, it can be promptly rescheduled. Of 176 appointments in the OA future visit group that were scheduled within 36 hours of the visit, 42 (24%) were scheduled after a prior missed appointment. Before OA at WFHC, the next available WCC visit appointment would have been in 3 to 6 weeks.

Randolph et al2 hypothesized that OA should improve immunization rates by decreasing the time between scheduling the appointment and the appointment date. Lannon et al3 found that the long wait between scheduling an appointment and the appointment date impeded the ability of low-income mothers to get medical care for their children. Our results support the hypothesis of Randolph et al.

In addition to OA, having insurance and being seen by a Spanish-speaking provider were also associated with improved on-time immunization rates. Our results support the importance of insurance in improving immunization rates found by others.8,26 The variable “Spanish-speaking provider” is a marker for the importance of immunizations for families who have recently immigrated from Mexico. Anderson et al27 found that Latino children whose mothers were the least acculturated were 3 to 5 times more likely to be up-to-date on immunizations as Latino children whose mothers were more acculturated.

The Denver Health system, with its access to an organization-wide immunization registry, assessment of immunizations at each visit, printed provider reminders of immunizations needed, follow-up after missed appointments, and mailed parent recalls for delayed immunizations, has attempted to optimize immunization rates. Open access scheduling appears to improve immunization rates further.

Practices using OA for at least 6 to 12 months report increased continuity of care.4,5 We found less continuity of care in the infants seen in the OA same day group than in the OA future visit group. The reason for this was differences in continuity among providers, not differences between the OA groups. One provider on maternity leave during part of the study may have accounted for some of the difference among providers. Our study duration was only 4 months.

This study had several limitations. Because of time and financial constraints, we were unable to randomize the infants, so we used a cluster design with provider randomization. Since the baseline group had no cluster randomization and we compared the 3 groups for missed appointment rates and on-time immunizations, we could not include the cluster randomization in this data analysis. However, comparison of the missed appointment and on-time immunization rates between the 2 OA groups including the effect of the cluster randomization yielded similar results as the comparison of the 3 groups without the cluster randomization. With randomization of the providers, some patients crossed between the 2 OA groups. In the analysis of continuity and immunization rates, infants were grouped based on the group they were in at their last visit. We have no data that the crossing between the 2 OA groups occurred more 1 way than the other. The time frame of the
study was short and results could have been affected by seasonal variations. However, quarterly monitoring of missed appointment and immunization rates of 1-year-old children has shown no seasonal variations.

The increased on-time immunization rates in the OA groups could be because of infants who never had an appointment scheduled, never got immunizations, and were not included in the study. Since the infants in the baseline and OA future visit groups had their appointments for WCC visits scheduled in the same manner, this was not a factor in the OA future visit group results. There was only a small number of infants who attended a 2-week visit, and who were not included in the study. There was no difference between the number of these infants who were not seen during the baseline period or during the OA period.

Our study population was low income and largely Mexican American. An evaluation of OA needs to be replicated in other ethnic and socioeconomic groups. Using a study design with complete cohorts seen in a non-OA and an OA system would give more robust data results for comparison of immunization rates.

CONCLUSIONS

Open access scheduling decreased the missed appointment rates for infant WCC visits. Scheduling 2-, 4-, and 6-month WCC visits 2 months ahead within an OA system allows the same improvement in on-time immunizations as scheduling same-day infant WCC. In a community health center that is part of a health care system that has attempted to optimize immunization rates, OA appears to have increased on-time immunization rates.

At WFC, we have continued to offer future-visit appointments for 2-, 4-, and 6-month WCC visits in OA. This allows parents to schedule ahead or the same day, whichever they prefer. Open access scheduling has improved access to care.

Accepted for Publication: April 20, 2006.

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Author Contributions: Dr O’Connor had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: O’Connor and Matthews. Acquisition of data: O’Connor and Matthews. Analysis and interpretation of data: O’Connor and Gao. Drafting of the manuscript: O’Connor, Matthews, and Gao. Critical revision of the manuscript for important intellectual content: O’Connor, Matthews, and Gao. Statistical analysis: O’Connor and Gao.

Funding/Support: This study was funded in part by Health Resources and Services Administration grant 2D54HP0054-04-00 to the Primary Care Research Unit, University of Colorado Health Sciences Center.

Acknowledgment: Thanks go to Stephen Vogler, MD, for persistently asking the question “How will we know that our infants are coming for care?”; Pete Gutierrez, BA, and Jeff Brown, MD, MPH, for their support of this project; the providers, nursing staff, and especially to Celina Magallanes and Joann Rios for their ability to accurately schedule patients in the 2 different open access systems; and Simon Hambridge, MD, PhD, and the other reviewers for their suggestions.

REFERENCES