Effect of Electronic Outreach Using Patient Portal Messages on Well Child Care Visit Completion
A Randomized Clinical Trial

Anne E. Berset, BA; Mary Carol Burkhardt, MD, MHA; Yingying Xu, PhD; Anne Mescher, MSN, RN, CPN; William B. Brinkman, MD, MEd, MSc

Abstract

IMPORTANCE Outreach messages to patients overdue for well child care (WCC) can be delivered different ways (ie, telephone calls and text messages). Use of electronic health record patient portals is increasingly common but their effectiveness is uncertain.

OBJECTIVE To determine the effectiveness of patient portal outreach messages, with and without the date of the last WCC, on the scheduling and completion of WCC visits and completion of vaccinations.

DESIGN, SETTING, AND PARTICIPANTS An intention-to-treat, multigroup, randomized clinical trial was conducted at 3 academic primary care practices from July 30 to October 4, 2021. The population included predominantly non-Hispanic Black, low-income children (age, 6-17 years) whose parent had an active portal account.

INTERVENTIONS Participants were randomized to the standard message, tailored message, or no message (control) group. Two messages were delivered to those in the message groups.

MAIN OUTCOMES AND MEASURES Outcomes included WCC visit scheduled within 2 weeks of the first intervention message, WCC visit completed within 8 weeks (primary outcome), and receipt of COVID-19 vaccine within 8 weeks.

RESULTS Nine hundred forty-five patients participated (mean [SD] age, 9.9 [3.3] years, 493 [52.2%] girls, 590 [62.4%] non-Hispanic Black, 807 [85.4%] publicly insured). Scheduling rates were 18.4% in the standard message group compared with the control group (9.5%; adjusted risk ratio [aRR], 1.97; 95% CI, 1.32-2.84) and 14.9% in the tailored message group (aRR, 1.57; 95% CI, 1.02-2.34) compared with the control group. Well child care visit completion rates were 24.1% in the standard message group compared with the control group (12.7%; aRR, 1.92; 95% CI, 1.38-2.60) and 19.4% in the tailored message group (aRR, 1.52; 95% CI, 1.06-2.13) compared with the control group. Among eligible children, rates of receiving the COVID-19 vaccine were 16.7% in the standard message group compared with the control groups (aRR, 3.41; 95% CI, 1.14-9.58) and 3.7% in the control groups (aRR, 4.84; 95% CI, 1.44-15.12).

CONCLUSIONS AND RELEVANCE In this randomized clinical trial, outreach messages delivered via electronic health record patient portals increased the rates of scheduling and completing WCC visits and receiving some vaccinations.

TRIAL REGISTRATION ClinicalTrials.gov Identifier: NCT04994691

Key Points

Question Does reminder messaging delivered via electronic health record patient portal affect the scheduling and completion of well child care (WCC) visits and delivery of vaccinations?

Findings In this randomized clinical trial that included 945 patients aged 6 to 17 years, the rates of scheduling and completing a WCC differed significantly between groups, with the portal message groups outperforming the control group. Rates of COVID-19 vaccine completion also significantly differed between groups.

Meaning The findings of this randomized clinical trial show that outreach patient portal messages increased the rates of scheduling and completing WCC visits and receiving some vaccinations.
Introduction

Preventive services were delayed during the COVID-19 pandemic, including well child care (WCC).\textsuperscript{1-3} Following pandemic shutdowns, vaccination rates decreased,\textsuperscript{4-6} with rates for non-Hispanic Black children disproportionately worsening\textsuperscript{6} and vaccine hesitancy increasing.\textsuperscript{7,8} Pervasive mistreatment, systemic racism, and neglect of Black and Latinx communities by the medical system have negatively impacted vaccine uptake among these populations.\textsuperscript{9,10} Outreach approaches may help in bringing children back for care, including text messages, telephone calls, mailings, school campaigns, community navigators, and home visitors.\textsuperscript{11} For example, reminders sent by letter and/or automated telephone calls have been reported to improve WCC visit completion rates among pediatric patients.\textsuperscript{12-14}

Electronic health record (EHR) portal messaging is a newer method to send outreach messages. Patient portals are secure online applications that give patients and parents 24-hour EHR access. Portal use in pediatric and adult primary care settings has increased since 2008.\textsuperscript{15-17} Portal reminders to schedule influenza vaccines among pediatric\textsuperscript{18,19} and adult\textsuperscript{20-23} patients have been minimally effective. Portal messages have successfully increased the scheduling, but not completion, of wellness visits among adults.\textsuperscript{24} Yet little is known about the effect of patient portal messages on the scheduling and completion of overdue pediatric WCC visits and research has highlighted racial, ethnic, and insurer disparities in portal activation and use among pediatric patients.\textsuperscript{25,26} To our knowledge, no pediatric studies have tested EHR portal messaging to increase WCC visits despite its potential to increase access by enabling direct scheduling of appointments, eliminating the constraint of calling during business hours.

We sought to determine the effect of EHR patient portal outreach messages, with and without the date of the last WCC, on the scheduling and completion of WCC visits among patients aged 6 to 17 years overdue for annual WCC visits. We tailored messages to include the date of the last WCC to address distortions of time perception experienced during the pandemic.\textsuperscript{27-29} We hypothesized that outreach messages would be superior to no message, and messages with tailoring would outperform standard messages. Secondary outcomes were vaccination rates for eligible patients.

Methods

Study Design and Randomization

We conducted a multigroup, randomized clinical trial from July 30 to October 4, 2021. One of us (Y.X.) generated a random allocation sequence stratified by clinic location using block randomization (with a block size of 3) and randomly assigned eligible patients (1:1:1) to 1 of 3 groups: standard message, tailored message, or control group (no message). The Cincinnati Children's Hospital Medical Center Institutional Review Board approved the study, granting a waiver of informed consent because there was minimal risk and the data were deidentified. We provide the trial protocol and statistical analysis plan in Supplement 1. This study followed the Consolidated Standards of Reporting Trials (CONSORT) reporting guideline.

Setting

The study occurred at 3 academic pediatric primary care practices. These practices serve a predominantly non-Hispanic Black, low-income population and provide more than 60 000 visits annually to 30 000 patients. The COVID-19 vaccine was available and could be given at WCC, ill, or vaccine-only encounters. At the start of the study, 44.4% of the patients had active portal accounts (ie, registered username and password). At age 13 years, patients gain account access and can sign assent designating at least 1 parent as a proxy, allowing parents to also receive portal messages. Parents can schedule appointments using the portal self-scheduling system available 24 hours daily or by calling the scheduling center Monday through Friday, 8:30 AM to 5:00 PM.
Population
We included patients aged 6 to 17 years who met the following eligibility criteria: (1) seen at 1 of our 3 primary care practices within 2 years, (2) no WCC visit in the past 365 days, (3) no WCC visit scheduled, (4) preferred language of English and/or Spanish, and (5) active EHR portal account. We downloaded an EHR report of potentially eligible patients that was limited to those aged 6 to 17 years who had not had a WCC in the past year. We collected the following EHR variables to characterize our sample and for consideration as covariates in analyses: parent communication preference; time since last WCC; absence of past patient receipt of measles, mumps, and rubella (MMR) vaccine or diphtheria, tetanus, and acellular pertussis (DTaP) vaccine as a proxy for declining childhood vaccinations; patient lifetime historical institutional no-show rate; and practice appointment availability. We also tracked the community incidence of COVID-19.30

Interventions
We sent 2 patient portal messages (ie, between 11:30 AM and 2:30 PM on Monday and Thursday) to each of the messages groups in 2 sequential weeks through our institution's EHR portal (MyChart; Epic Systems Corp), using the parent's preferred language. Parent preferences are elicited and recorded when first registered in the EHR. Parents receive an email informing them of a message in the patient portal and a link to log in and access the message.

We crafted the messages based on the extant literature11 and feedback from parents, as well as outreach medical assistants who call and text with families daily. Examples of patient portal messages are given in eTable 2 in Supplement 2. The standard messages referenced the patient's first name, reminded parents their child was due for a WCC visit, and asked them to schedule using the portal or by calling the number provided. The tailored messages included the information in the standard message, and additionally included the date of the patient's last WCC and patient age. We randomly assigned the standard message group to receive the intervention the first week and the tailored message group the following week. Interpreter services translated our messages into Spanish. One of us (A.E.B.) completed a medical record audit at the end of the study to determine whether messages had been read.

Outcomes
Our primary outcome was WCC visit completion within 8 weeks of the date we sent the first message or the date of randomization for the control group. Secondary outcomes included appointment scheduled within 2 weeks and receipt of first COVID-19 vaccination within 8 weeks among eligible patients (aged ≥12 years at the time of the study). Post hoc secondary outcomes included patient receipt of DTaP vaccine, human papillomavirus (HPV) vaccine, and meningococcal conjugate vaccine (MCV4) among eligible patients. An exploratory analysis examined whether children in the tailored message group who did and did not complete a WCC visit differed on time since the last WCC. We assessed all outcomes using EHR data.

Sample Size
We calculated the study sample size based on the hypothesis that 20% of patients in the standard message, 30% of patients in the tailored message, and 2% of those in the control group would complete a WCC visit within 8 weeks. We based our hypotheses on effect sizes documented for automated text reminders on immunization rates.11 We calculated the sample size based on the hypothesized proportions. To detect a difference in WCC visit completion for all 3 comparisons (standard vs control, tailored vs control, and standard vs tailored) with 80% power at 5% significance level, we required a sample size of 293 per group (879 participants overall). We blinded clinical practice teams and our outcome assessor by concealing group allocation.
Statistical Analysis

We conducted descriptive analyses to characterize the participants in terms of demographic characteristics and other potential covariates. We conducted intention-to-treat analysis to compare outcomes among the 3 groups. We used logistic regression models, adjusting for characteristics that meaningfully differed across the groups, to examine each of our binary outcomes. We obtained odds ratios and then converted to risk ratio (RRs) using standard methods, with statistical significance defined as 2-sided \( P < .05 \). Because some patients were not sent messages as intended, we conducted a per-protocol analysis, excluding patients who were not sent at least 1 message. Because our study design did not account for siblings or others living in the same household, we also conducted sensitivity analyses for our intention-to-treat and per-protocol analyses, excluding patients in the control group who shared the same telephone number and/or proxy (parent on the account) with another patient allocated to a message group. We conducted all analyses using SAS, version 9.4 (SAS Institute Inc).

Results

Baseline Characteristics

Of the 945 children (493 [52.2%] girls and 452 [47.8%] boys) who were eligible and randomized (Figure 1), most were non-Hispanic Black (590 [62.4%]) and had public insurance (807 [85.4%]) (Table 1). Mean (SD) age was 9.9 (3.3) years. We observed meaningful differences between the groups on insurance status, which we adjusted for in subsequent analyses. The estimates from adjusted models and those from unadjusted models were very close, so we present adjusted estimates herein and provide unadjusted estimates in eTable 1 in Supplement 2. Few patients (1.0%) appeared to have declined childhood vaccines based on our proxy measure of not having received at least 1 past dose of MMR and DTaP. The mean time since last WCC was 17 months (range, 12-24

Figure 1. Consolidated Standards of Reporting Trials Diagram

- 4168 Children aged 6-17 y without WCC in the past year assessed for eligibility
- 3223 Excluded
  - 3179 Inactive EHR portal account
  - 17 WCC scheduled in future
  - 19 Non-English or Spanish speaker
  - 8 Receiving primary care at outside practice

- 945 Randomized
  - 315 Randomized to standard message group
    - Monday message 312 Received message
    - Thursday message 289 Received message
    - 315 Analyzed
      - 315 ITT analysis
      - 315 ITT sensitivity analysis
      - 312 Per-protocol analysis
      - 312 Per-protocol sensitivity analysis
  - 315 Randomized to tailored message group
    - Monday message 312 Received message
    - Thursday message 267 Received message
    - 315 Analyzed
      - 315 ITT analysis
      - 315 ITT sensitivity analysis
      - 286 Per-protocol analysis
      - 286 Per-protocol sensitivity analysis
  - 315 Randomized to control group
    - 315 Analyzed
      - 315 ITT analysis
      - 315 ITT sensitivity analysis
      - 261 Per-protocol analysis
      - 261 Per-protocol sensitivity analysis

EHR indicates electronic health record; ITT, intention-to-treat; and WCC, well child care.

* Patients excluded had higher percentages of younger, Black, and self-pay and publicly insured patients compared with enrolled patients.
months). All practice locations maintained WCC appointment availability less than or equal to 30 days throughout the study (median, 12 days; range 1-30 days). We were unable to accurately ascertain when parents read the patient portal message because the EHR time stamp updated anytime the message was viewed. Thus, we did not pursue further analysis. The Delta variant of SARS-CoV-2 spread in our region during the study time frame, with COVID-19 community 7-day moving average increasing from 94 to 568 per 100,000.

**Intention-to-Treat Analyses**

There were 58 of 315 patients (18.4%; adjusted RR [aRR], 1.97; 95% CI, 1.32-2.84) in the standard message, 47 of 315 patients (14.9%; aRR, 1.57; 95% CI, 1.02-2.34) in the tailored message, and 30 of 315 patients (9.5%) in the control groups who scheduled a WCC visit within 2 weeks (Table 2). The standard message and tailored message groups had higher rates of scheduling a WCC compared with the control group (Figure 2). Well child care visit completion rates within 8 weeks were also higher in the standard message (24.1%; aRR, 1.92; 95% CI, 1.38-2.60) and tailored message (19.4%; aRR, 1.52; 95% CI, 1.06-2.13) groups compared with the control group (12.7%). Among those eligible to receive the COVID-19 vaccine (only approved for patients aged ≥12 years old at the time of the

### Table 1. Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%)</th>
<th>Standard message</th>
<th>Tailored message</th>
<th>Control group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique patients, No.</td>
<td>945</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age range, y</td>
<td></td>
<td></td>
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<tr>
<td>6-8</td>
<td>315</td>
<td>315</td>
<td>315</td>
<td>945</td>
<td></td>
</tr>
<tr>
<td>9-11</td>
<td>133 (42.2)</td>
<td>134 (42.5)</td>
<td>137 (43.5)</td>
<td>404 (42.8)</td>
<td></td>
</tr>
<tr>
<td>12-14</td>
<td>98 (31.1)</td>
<td>98 (31.1)</td>
<td>96 (30.5)</td>
<td>292 (30.9)</td>
<td></td>
</tr>
<tr>
<td>15-17</td>
<td>40 (12.7)</td>
<td>38 (12.1)</td>
<td>33 (10.5)</td>
<td>111 (11.7)</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>152 (48.3)</td>
<td>167 (53.0)</td>
<td>174 (55.2)</td>
<td>493 (52.2)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>163 (51.7)</td>
<td>148 (47.0)</td>
<td>141 (44.8)</td>
<td>452 (47.8)</td>
<td></td>
</tr>
<tr>
<td>Race and ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Indian or Alaska Native, non-Hispanic</td>
<td>0</td>
<td>1 (0.3)</td>
<td>0</td>
<td>1 (0.1)</td>
<td></td>
</tr>
<tr>
<td>Asian, non-Hispanic</td>
<td>10 (3.2)</td>
<td>4 (1.3)</td>
<td>5 (1.6)</td>
<td>19 (2.0)</td>
<td></td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>184 (58.4)</td>
<td>195 (61.9)</td>
<td>211 (67.0)</td>
<td>590 (62.4)</td>
<td></td>
</tr>
<tr>
<td>Black, Hispanic</td>
<td>3 (1.0)</td>
<td>1 (0.3)</td>
<td>2 (0.6)</td>
<td>6 (0.6)</td>
<td></td>
</tr>
<tr>
<td>Middle Eastern, non-Hispanic</td>
<td>0</td>
<td>1 (0.3)</td>
<td>0</td>
<td>1 (0.1)</td>
<td></td>
</tr>
<tr>
<td>Multiracial, non-Hispanic</td>
<td>21 (6.7)</td>
<td>15 (4.8)</td>
<td>15 (4.8)</td>
<td>51 (5.4)</td>
<td></td>
</tr>
<tr>
<td>Multiracial, Hispanic</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
<td>3 (0.3)</td>
<td></td>
</tr>
<tr>
<td>Native Hawaiian and other Pacific Islander, Hispanic</td>
<td>0</td>
<td>0</td>
<td>1 (0.3)</td>
<td>1 (0.1)</td>
<td></td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>82 (26.0)</td>
<td>73 (23.2)</td>
<td>71 (22.5)</td>
<td>226 (23.9)</td>
<td></td>
</tr>
<tr>
<td>White, Hispanic</td>
<td>5 (1.6)</td>
<td>10 (3.2)</td>
<td>3 (1.0)</td>
<td>18 (1.9)</td>
<td></td>
</tr>
<tr>
<td>Missing data, non-Hispanic</td>
<td>3 (1.0)</td>
<td>3 (1.0)</td>
<td>1 (0.3)</td>
<td>7 (0.7)</td>
<td></td>
</tr>
<tr>
<td>Missing data, Hispanic</td>
<td>6 (1.9)</td>
<td>11 (3.5)</td>
<td>5 (1.6)</td>
<td>22 (2.3)</td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public (ie, Medicaid)</td>
<td>280 (88.9)</td>
<td>275 (87.3)</td>
<td>252 (80.0)</td>
<td>807 (85.4)</td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>29 (9.2)</td>
<td>33 (10.5)</td>
<td>50 (15.9)</td>
<td>112 (11.9)</td>
<td></td>
</tr>
<tr>
<td>Self-pay</td>
<td>6 (1.9)</td>
<td>7 (2.2)</td>
<td>13 (4.1)</td>
<td>26 (2.8)</td>
<td></td>
</tr>
<tr>
<td>Childhood vaccine refusal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No past MMR and DTaP</td>
<td>2 (0.6)</td>
<td>4 (1.3)</td>
<td>3 (1.0)</td>
<td>9 (1.0)</td>
<td></td>
</tr>
<tr>
<td>Patient lifetime historical no-show rate, mean (SD)</td>
<td>0.14 (0.28)</td>
<td>0.18 (0.33)</td>
<td>0.17 (0.33)</td>
<td>0.16 (0.32)</td>
<td></td>
</tr>
<tr>
<td>Time since last WCC, mean (range)</td>
<td>17.0 (12.0-24.0)</td>
<td>17.2 (12.0-24.0)</td>
<td>16.9 (12.0-24.0)</td>
<td>17.0 (12.0-24.0)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: DTaP, diphtheria and tetanus toxoids and acellular pertussis; MMR, measles, mumps, and rubella; WCC, well child care.
study, 14 patients (16.7%) in the standard message group, 4 patients (4.8%; aRR, 3.41; 95% CI, 1.14-9.58) in the tailored message group, and 3 patients (3.7%; aRR, 4.84; 95% CI, 1.44-15.12) in the control group received the vaccine within 8 weeks. The standard message group had higher rates of receiving the COVID-19 vaccine compared with the tailored message and control groups. Among those eligible to receive the DTaP, HPV, and/or MCV4 vaccines during the study period, the rates of receiving these vaccines within 8 weeks did not differ significantly between groups (Table 2). Rates of receiving these vaccines within 8 weeks across the standard message group vs tailored message group vs control group were as follows: DTaP, 19% vs 18% vs 25%; HPV, 27% vs 17% vs 14%; and

**Table 2. Intention-to-Treat Rates of Completion**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No./total No. (%)</th>
<th>Standard message</th>
<th>Tailored message</th>
<th>Control group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCC scheduled within 2 wk</td>
<td>58/315 (18.4)</td>
<td>47/315 (14.9)</td>
<td>30/315 (9.5)</td>
<td>135/945 (14.3)</td>
<td></td>
</tr>
<tr>
<td>WCC completed within 8 wk</td>
<td>76/315 (24.1)</td>
<td>61/315 (19.4)</td>
<td>40/315 (12.7)</td>
<td>177/945 (18.7)</td>
<td></td>
</tr>
<tr>
<td>Receipt of COVID vaccination within 8 wk</td>
<td>14/84 (16.7)</td>
<td>4/83 (4.8)</td>
<td>3/82 (3.7)</td>
<td>21/249 (8.4)</td>
<td></td>
</tr>
<tr>
<td>Receipt of DTaP within 8 wk</td>
<td>6/32 (30.0)</td>
<td>6/34 (30.0)</td>
<td>8/32 (40.0)</td>
<td>20/98 (20.4)</td>
<td></td>
</tr>
<tr>
<td>Receipt of HPV within 8 wk</td>
<td>13/49 (44.8)</td>
<td>9/52 (31.0)</td>
<td>7/50 (24.1)</td>
<td>29/151 (19.2)</td>
<td></td>
</tr>
<tr>
<td>Receipt of MCV4 within 8 wk</td>
<td>10/54 (32.3)</td>
<td>12/57 (38.7)</td>
<td>9/49 (29.0)</td>
<td>31/160 (19.4)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: HPV, human papillomavirus vaccine; MCV4, meningococcal conjugate vaccine; DTaP, diphtheria and tetanus toxoids and acellular pertussis; WCC, well child care.

**Analysis includes all patients eligible to receive this vaccine during the 8-week study period.**

The intention-to-treat and per protocol analyses were adjusted for insurance type, as those in the control group appeared to have fewer patients with public insurance compared with the standard and tailored message groups. HPV indicates human papillomavirus; MCV4, meningococcal conjugate vaccine; TDaP, tetanus, diphtheria, acellular pertussis; and WCC, well child care.

**a** The intent-to-treat and per-protocol analyses were adjusted for insurance type, as those in the control group appeared to have less patients with public insurance compared with the standard and tailored message groups.

**b** Analysis includes all patients eligible to receive this vaccine during the 8-week study period.
MCV4, 19% vs 21% vs 18%. Due to high baseline rates, by the end of the study, most participants in
the sample had received the DTaP (76%) and the first dose of MCV4 (75%) vaccines and the first
dose of the HPV (62%) vaccine. There was no significant difference in the mean (SD) time since last
WCC between those who did (17.16 [3.93] months) and did not (17.18 [4.08] months) complete a WCC
in the tailored message group (\(P = .98\)).

**Sensitivity Analysis**

We identified 54 of 315 patients in the control group (17%) who shared the same telephone number
and/or account proxy with 1 or more patients included in a message group, indicating participants
were likely siblings. Excluding patients in the control group with siblings in a message group did not
change the intention-to-treat pattern of the results.

**Process Measures**

Reasons for not sending the intended intervention on both days included scheduled a WCC visit after
randomization but before sending first message (standard: \(n = 1\) of 315; tailored: \(n = 29\) of 315),
scheduled a WCC visit after the first message (standard: \(n = 25\) of 315; tailored: \(n = 19\) of 215), and
patient portal account inactivated after randomization but before message sent (standard: \(n = 2\)
of 315). Delivery of at least 1 patient portal message had high success rates across the standard message
(99%) and tailored message (91%) groups (Figure 1). Therefore, our per-protocol analysis included
a total of 913 patients who received the intended intervention.

**Per Protocol Analyses**

Overall, the pattern of results was the same as the intention-to-treat analysis (Table 3 and Figure 2),
with all group differences previously observed in intention-to-treat analysis remaining significant
and in the same direction. Sensitivity analysis excluding patients in the control group with siblings in
a message group did not change the pattern of results.

**Discussion**

In this randomized clinical trial of patient portal outreach messages among predominantly
non-Hispanic Black children overdue for well care with active portal accounts, the standard message
and tailored message both positively affected WCC scheduling and completion. The standard
message group outperformed the tailored message and control groups on COVID-19 vaccine
completion among eligible patients.

There was a significant increase in the scheduling and completion of appointments after
receiving the standard and tailored message compared with no message, indicating that simple
outreach nudges via patient portal may prompt action. The standard message group had higher rates
of receiving COVID-19 vaccination within 8 weeks, suggesting that messages that reengage patients

**Table 3. Per Protocol Rates of Completion, No. (%)**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No./total No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard message</td>
</tr>
<tr>
<td>WCC scheduled within 2 wk</td>
<td>59/312 (18.9)</td>
</tr>
<tr>
<td>WCC completed within 8 wk</td>
<td>76/312 (24.4)</td>
</tr>
<tr>
<td>Receipt of COVID vaccination within 8 wk*</td>
<td>14/81 (17.3)</td>
</tr>
<tr>
<td>Receipt of DTaP within 8 wk*</td>
<td>6/32 (30.0)</td>
</tr>
<tr>
<td>Receipt of HPV within 8 wk*</td>
<td>12/47 (48.0)</td>
</tr>
<tr>
<td>Receipt of MCV4 within 8 wk*</td>
<td>10/54 (33.3)</td>
</tr>
</tbody>
</table>

Abbreviations: HPV, human papillomavirus vaccine; MCV4, meningococcal conjugate
vaccine; DTaP, diphtheria and tetanus toxoids and acellular pertussis; WCC, well
child care.

* Analysis includes all patients eligible to receive this vaccine during the 8-week
study period.
subsequently provide opportunities to promote healthy behaviors, such as vaccine acceptance. A focus group found that families with patient portal accounts prefer straightforward, brief, and user-friendly messages. This indication of preference may help explain our finding that the standard message outperformed the tailored message on the COVID-19 vaccine completion outcome. Families may have been distracted by the additional information related to the child's age and date of last WCC in the tailored message. Including the date of the last WCC should have made salient that the child was overdue for a WCC, addressing distortions of time perception experienced by many during the pandemic. Yet some families may have perceived that differently if unfamiliar with the recommended periodicity schedule. In addition, we did not find a significant difference in time since the last WCC on WCC completion within 8 weeks among patients in the tailored message group. Further research is needed to assess how varying message content impacts outcome completion.

To our knowledge, no previous studies have determined the effect of patient portal messaging to promote WCC scheduling and completion among pediatric patients overdue for care. Nudge health maintenance reminders sent via the patient portal were associated with increased appointment scheduling rates among adults aged 65 years and older; however, no significant differences were observed between the control and nudge groups on wellness visit completion rates. Success rates for studies using text messaging or telephone call interventions to promote completion of well child appointments range from 14% to 72%. Differences in rates of WCC completion compared with these studies may be due to (1) longer duration of follow-up in earlier studies, ranging from 6 to 18 months; (2) more than half the sample in previous studies had a WCC in the 12 months before intervention vs none in ours; or (3) earlier studies used higher intensity interventions. Using patient portals offers an additional layer in the approach to engage families, as outreach attempts need to be varied, especially in marginalized populations. Future qualitative research should be done to (1) incorporate multiple communication modes, such as videos and storytelling; (2) offer and encourage choice; (3) develop patient-centered messages by cocreating with families; and (4) use interventions that leverage effective community partnerships and trust.

Past research on patient portal messages has largely examined its use among adult, non-Hispanic White, and privately insured populations. In contrast, our study examined the use of patient portal messages among predominantly low-income non-Hispanic Black pediatric patients, a traditionally marginalized and harder to reach population. We conducted a separate trial with patients with an inactive EHR portal account to examine text and telephone reminder messages in that population, and rates of WCC completion were lower, ranging from 10% to 14%. Demonstrating an increased rate of completing WCC visits suggests that patient portal messaging may be a valid way of reaching populations that have been historically marginalized. Effects may be even higher in populations that are traditionally more likely to use EHR portals or in nonpandemic times.

Compared with those included in our study, patients excluded due to lack of an active portal account differed on race (higher proportion of Black children), age (younger), and insurance (higher proportion with self-pay and publicly insured children). Previous research highlights substantial disparities in pediatric patient portal use among Medicaid-enrolled, low-income, and Black and Latinx patients. Others attribute these differences to less internet access or computers, yet cell phone use and desire to receive health information via cell phones has been found to be prevalent among low-income populations. Past research has found that White patients are more likely to receive access codes to activate their portal account compared with Black or Latinx patients. In our practices, portal enrollment opportunities are offered at appointments, so patients eligible for the present study (ie, no WCC visit in the past 12 months) had fewer recent opportunities to enroll than children seen frequently. It is unclear whether the disparities related to patient portal use relates to discrimination by the medical system, health literacy barriers, or differences in how families use the internet. Regardless, more research is needed to understand and promote patient portal use among vulnerable populations.
Strengths and Limitations
Study strengths include the use of a clinically relevant, presumably low-cost and widely available intervention; a large, historically marginalized, at-risk sample; ascertainment of important outcomes; and intention-to-treat design. Our study also has limitations. It was conducted in academic primary care practices serving low-income, predominantly Black patients, which limits the generalizability of results, but complements past reports by focusing on a marginalized group. Due to challenges related to attribution and time since the last appointment, it is possible some children were no longer current patients. The groups in this study were contaminated with children in the same household (ie, same telephone number and/or caregiver listed) being allocated to different groups. This led to some members of the control group being exposed to messages, although sensitivity analyses show this did not impact our estimates. We were unable to accurately determine the date messages were first read, as this variable is updated every time the message is viewed. Our messaging interventions were developed by a study team that does not reflect the racial composition of our patient population. We acknowledge that outreach messages we view as helpful may still lack relevance to the lived experiences of marginalized populations. Although we received feedback from parents and outreach medical assistants on message content, future effort is needed to seek deeper engagement in intervention development.

Conclusions
In this randomized clinical trial, outreach messages delivered via EHR patient portals increased the rates of scheduling and completing overdue WCC visits and receiving the COVID-19 vaccine. Additional efforts are needed to reengage at-risk populations and recover preventive services missed during the pandemic.

ARTICLE INFORMATION
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Corresponding Author: Anne E. Berset, BA, General & Community Pediatrics, Cincinnati Children’s Hospital Medical Center, 3333 Burnet Ave, MLC 7035, Cincinnati, OH 45229 (anne.berset@cchmc.org).
Author Affiliations: Division of General & Community Pediatrics, Cincinnati Children’s Hospital Medical Center, Cincinnati, Ohio (Berset, Burkhardt, Xu, Mescher, Brinkman); Department of Pediatrics, University of Cincinnati College of Medicine, Cincinnati, Ohio (Burkhardt, Brinkman).
Author Contributions: Ms Berset had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: Berset, Burkhardt, Mescher, Brinkman.
Acquisition, analysis, or interpretation of data: Berset, Xu, Brinkman.
Drafting of the manuscript: Berset, Burkhardt, Mescher, Brinkman.
Critical revision of the manuscript for important intellectual content: Berset, Xu, Mescher, Brinkman.
Statistical analysis: Xu.
Administrative, technical, or material support: Burkhardt, Mescher, Brinkman.
Supervision: Burkhardt, Mescher, Brinkman.
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REFERENCES


SUPPLEMENT 1.
Trial Protocol

SUPPLEMENT 2.
eTable 1. Unadjusted Risk Ratios (RR) for Intent-to-Treat and Per Protocol Analyses
eTable 2. Example of Patient Portal Outreach Messages

SUPPLEMENT 3.
Data Sharing Statement