## Effect of Provider Prompts on Adolescent Immunization Rates: A Randomized Trial



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### ABSTRACT

**OBJECTIVE:** Adolescent immunization rates are suboptimal. Experts recommend provider prompts at health care visits to improve rates. We assessed the impact of either electronic health record (EHR) or nurse- or staff-initiated provider prompts on adolescent immunization rates.

**METHODS:** We conducted a randomized controlled trial, allocating practices in 1 of 2 practice-based research networks (PBRN) to provider prompts or standard-of-care control. Ten primary care practices participated, 5 intervention and 5 controls, each matched in pairs on urban, suburban, or rural location and practice type (pediatric or family medicine), from a PBRN in Greater Rochester, New York (GR-PBRN); and 12 practices, 6 intervention, 6 controls, similarly matched, from a national pediatric continuity clinic PBRN (CORNET). The study period was 1 year per practice, ranging from June 2011 to January 2013. Study participants were adolescents 11 to 17 years attending these 22 practices; random sample of chart reviews per practice for baseline and postintervention year to assess immunization rates (n = 7,040 total chart reviews for adolescents with >1 visit in a period). The intervention was an EHR prompt (4 GR-PBRN and 5 CORNET practice pairs) (alert) that appeared on providers' computer screens at all office visits, indicating the specific immunizations that adolescents were recommended to receive. Staff prompts (1 GR-PBRN pair and 1 CORNET pair) in the form of a reminder sheet was

placed on the provider's desk in the exam room indicating the vaccines due. We compared immunization rates, stratified by PBRN, for routine vaccines (meningococcus, pertussis, human papillomavirus, influenza) at study beginning and end.

**Results:** Intervention and control practices within each PBRN were similar at baseline for demographics and immunization rates. Immunization rates at the study end for adolescents who were behind on immunizations at study initiation were not significantly different for intervention versus control practices for any vaccine or combination of vaccines. Results were similar for each PBRN and also when only EHR-based prompts was assessed. For example, at study end, 3-dose human papillomavirus vaccination rates for GR-PBRN intervention versus control practices were 51% versus 53% (adjusted odds ratio 0.96; 95% confidence interval 0.64–1.34); CORNET intervention versus control rates were 50% versus 42% (adjusted odds ratio 1.06; 95% confidence interval 0.68–1.88).

**CONCLUSIONS AND RELEVANCE::** In both a local and national setting, provider prompts failed to improve adolescent immunization rates. More rigorous practice-based changes are needed.

**Keywords:** adolescent immunization; EHR; HPV; influenza; meningococcal; outreach; provider prompt; Tdap

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SINCE 2005, ADOLESCENT immunization delivery has become increasingly important but also more complex, the result of age-specific recommendations of vaccines to prevent tetanus, diphtheria, pertussis (Tdap), meningococcal (MCV4), and human papillomavirus (HPV) infections and universal recommendation of influenza vaccination for all persons, including teens.<sup>1,2</sup> Unfortunately, despite substantial research, publicity, and efforts by experts to optimize adolescent immunization delivery, immunization rates are suboptimal.<sup>2,3</sup> In 2012, 85% of adolescents aged 13 to 17 years had received Tdap, 74% had received MCV4, and  $\approx 40\%$  had received an influenza vaccination<sup>4</sup>; 54% of girls (and 21% of boys) aged 13 to 17 years had received >1 HPV vaccine, while 33% of girls and 7% of boys had received 3 doses.<sup>2</sup> Finally, some disparities exist, with minority adolescents having lower completion rates of HPV vaccine and lower rates of influenza vaccination.<sup>5–8</sup>

Experts, including the Task Force on Community Preventive Services,9,10 recommend that primary care practices use one or more strategies to optimize adolescent immunization delivery. One recommended strategy is health care provider prompts to reduce missed opportunities for vaccinations.<sup>11,12</sup> Provider prompts, or alerts, are produced by nurse/staff, or by the electronic health record (EHR) at the time of patient visits to remind health care providers to administer age-appropriate vaccinations. Few primary care practices use provider prompts for adolescent immunizations as a result of implementation barriers such as complexity and cost.<sup>13</sup> Further, few studies have evaluated provider prompts' effectiveness among adolescent populations, and those that have reported mixed results. One study showed no benefit of prompts for influenza vaccinations among children and adolescents with asthma,<sup>14</sup> while a recent study in a hospital-based primary care system using a single EHR showed benefit for HPV vaccination initiation but not subsequent doses.<sup>15</sup> Thus, although some experts recommend provider prompts for a variety of preventive measures,<sup>16–20</sup> little evidence supports their effectiveness for adolescent immunizations. Of note, earlier studies demonstrated that nurse/staff prompts had variable success in reducing missed opportunities for childhood vaccinations.<sup>11,12,21–24</sup>

We conducted a randomized controlled trial in 2 practice-based research networks (PBRNs), an upstate New York network and a national network of pediatric continuity clinics, to evaluate the impact of provider prompts on adolescent immunization rates. We used community-based participatory research methods for practitioners to reach a consensus on the intervention to be studied, which converged on provider prompts, and then conducted the intervention in both PBRNs. We hypothesized that provider prompts would improve adolescent immunization rates.

#### METHODS

#### SETTING

The study was based in both a local and a national PBRN. The Greater Rochester PBRN (GR-PBRN)<sup>25</sup> consists of 85 primary care practices, including 44 pediatric and 14 family medicine practices serving >80% of all children in the Monroe County, New York, region, which has a population of 750,000. The national Continuity Clinic Research Network (CORNET) consists of 73 pediatric continuity clinics in 36 states serving over 683,000 children and adolescents; many are large hospital-based continuity clinics.

#### STUDY DESIGN

Using concepts of diffusion theory outlined by Rogers,<sup>26</sup> we performed a 3-part mixed-methods study<sup>27</sup> to 1) determine a consensus-driven, practice-based strategy to improve adolescent immunization rates, 2) test the strategy in 2 PBRNs, and 3) evaluate practitioner perceptions of the interventions.

#### SELECTION OF A PRACTICE-BASED INTERVENTION

We first conducted a mixed-methods mailed/online survey of primary care practices plus qualitative key informant interviews of a subset of practices in the 2 PBRNs to: 1) ascertain which of the recommended adolescent immunization strategies practitioners were using and would be interested in adopting (reported previously<sup>28</sup>); 2) develop consensus about which specific intervention to evaluate on the basis of practitioner perception of the intervention's feasibility, effectiveness, and sustainability; and 3) identify practices that were interested in participating in intervention evaluation. Two-thirds of GR-PBRN and three-quarters of CORNET practices selected provider immunization prompts delivered either by nurse/staff during patient visits, or delivered by EHR for study.

#### **EVALUATION OF PROVIDER PROMPTS**

We conducted a randomized controlled trial, stratified by PBRN, to test the impact of provider prompts on increasing adolescent immunization rates. Intervention practices within each PBRN were matched with control practices in pairs by suburban, urban, or rural status and practice type (pediatrics or family medicine). The 12-month randomized controlled trial spanned June 6, 2011, to June 5, 2012 (GR-PBRN), and September 20, 2011, to January 30, 2013 (CORNET; intervention/control practice pairs had staggered starts over a 4-month period, but for each practices the study time period was the same).

#### Assessment of Practitioner Perceptions of the Intervention

After the intervention, we conducted a qualitative phone interview of one practitioner from all intervention practices to assess perceptions of feasibility, acceptability, and sustainability of the provider prompts. We used constructs from diffusion theory as the conceptual framework.<sup>26</sup> Two authors [SH, PV (GR-PBRN); SH, ND (CORNET)] performed, documented, and analyzed interviews.

The research subjects review board of the University of Rochester approved all 3 study components; the 14 CORNET sites required additional institutional review board approval. Parent and patient informed consents were not required because the intervention involved a practice-based intervention recommended for general use.<sup>9</sup>

#### PARTICIPANTS

#### PRIMARY CARE PRACTICES AND RANDOMIZATION

Fourteen GR-PBRN and 15 CORNET practices agreed, before randomization, to participate in the randomized controlled trial intervention (Figure). Our power calculation called for 6 pairs (12 sites) per PBRN to be able to detect an increase of 10 percentage points (40% to 50%) in immunization rates with 80% power, an average of 160 patients per practice, a 2-tailed alpha of 5% and an intraclass correlation (ICC) of 0.01 (or 13 percentage points with ICC = 0.02); an ICC of 0.01 to 0.02 is typical for primary care trials. Within the GR-PBRN, we created

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