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Text message reminders for vaccination of adolescents with chronic medical conditions: A randomized clinical trial

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ABSTRACT

Background: Many adolescents with chronic medical conditions (CMCs) are at risk of vaccine-preventable infection, yet are frequently under-vaccinated. Text message reminders, particularly those with embedded educational information, have been shown to increase general pediatric vaccination. Their use has not been studied specifically among adolescents with CMCs.

Methods: Eligible parents of adolescents with CMCs receiving care at one of 4 academically-affiliated pediatric clinics and requiring human papillomavirus (first dose), influenza, and/or pneumococcal polysaccharide vaccines were randomized in 4 consecutive cohorts to receive text message vaccine reminders with or without embedded educational information ("educational" *vs.* "plain" arm, respectively). Educational reminders, including one interactive message, addressed infection risk, vaccine safety/efficacy, and physician recommendations. Up to 5 weekly and 2 booster reminders were sent (October 2014–January 2015). Receipt of any needed vaccine and missed vaccination opportunities by 4, 12, and 24 weeks after the initial reminder were compared between arms.

Results: Of randomized parents (n = 295), 175 (59.3%) were Spanish-speaking; most had adolescents with CMCs who were 13–17 years (n = 229; 77.6%) and publically insured (n = 272; 92.5%). Baseline demographics and parental vaccine beliefs were similar between arms. More adolescents in the plain *vs.* educational reminder arm received any needed vaccine by 4 weeks (31.9% *vs.* 22.7%, adjusted relative risk [aRR] 1.47, 95% CI 1.01–2.14), but not by 12 or 24 weeks. Plain reminders were noted in post hoc analyses to have a greater effect than educational reminders in certain sub-populations, including 11–12 year-olds and those sent the initial reminder in early fall. Fewer adolescents in the plain *vs.* educational reminder arm had a missed vaccination opportunity by 4 weeks (10.9% *vs.* 41.3%; aRR 0.21, 95% CI 0.07–0.60), but not by 12 or 24 weeks.

Conclusion: Plain text message vaccine reminders appear to have a positive effect compared to educational ones in the short-term and for certain families.

Conclusion: Trial registration: NCT02231957 (www.clinicaltrials.gov)

1. Introduction

A growing number of adolescents have a chronic medical condition (CMC) [1–3]. The U.S. Advisory Committee on Immunization Practices (ACIP) recommends that all adolescents receive human papillomavirus (HPV), tetanus-diphtheria-acellular pertussis, meningococcal, and influenza vaccines [4–7]. Certain adolescents may additionally require other vaccines such as pneumococcal polysaccharide (PPSV) due to underlying conditions or treatment

Abbreviations: ACIP, Advisory Committee on Immunization Practices; CIR, New York City Immunization Registry; CMC, chronic medical condition; EHR, electronic health record; HPV, human papillomavirus; PPSV, pneumococcal polysaccharide.

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regimens that increase their risk of infection or associated complications [8]. Despite these recommendations, vaccination coverage of adolescents with CMCs remains suboptimal, often falling below *Healthy People 2020* target levels [9–17]. Reasons for this remain unclear, although multilevel factors likely contribute [16,18–21].

Strategies to promote vaccination of adolescents with CMCs are needed. Text message reminder/recall has been effective in improving vaccination in the general adolescent population [22–25], but has not been studied specifically among adolescents with CMCs. Parents of these adolescents may have different vaccine-related informational needs due to their adolescent's specific CMCs, interactions with the healthcare system, and other factors that disproportionately or uniquely affect them [18]. Educational messages could be particularly beneficial. Recently, text message reminders with embedded educational information and interactive features were shown to have a greater effect than plain text message reminders in the general pediatric population [24,26]. This study aimed to compare the effect of plain *vs.* educational text message reminders on receipt of needed vaccines among adolescents with CMCs. We hypothesized that vaccine receipt would be higher among adolescents whose parents were sent educational reminders.

2. Methods

2.1. Study design, setting, and population

This randomized clinical trial compared the effect of plain *vs.* educational text message reminders on receipt of HPV, influenza, and PPSV vaccines among eligible adolescents with CMCs. Baseline parent and provider surveys were also conducted. The study was approved by the Columbia University Medical Center Institutional Review Board.

This trial was conducted in 4 pediatric primary care clinics affiliated with an academic medical center. During the study period (April 2014–June 2015), the clinics sent text message reminders for 4 special influenza vaccination events; no other reminder/recall or vaccine-promoting strategies were used. Baseline vaccination coverage of adolescents aged 11–17 years with CMCs in these clinics was 33.4% for HPV (first dose), 67.5% for influenza, and 7.4% for PPSV (first dose) as of June 15, 2013 (among those eligible as of October 1, 2012).

Parents were eligible if their adolescent was 11–17 years, had ≥1 CMC, had visited a participating clinic in the last 12 months, and had a parental cell phone number listed in the medical center's registration system. Exclusion criteria included parents who did not speak English or Spanish, were unable/unwilling to receive text message reminders, or had moved or anticipated moving from the area in the coming 12 months. Only one adolescent was included per family (determined by next birthday). CMCs were defined by the presence of pre-specified condition(s) based upon ACIP recommendations and existing literature [2,4–8,27–29] (Appendix A) or by provider designation in response to the following questions in the electronic health record (EHR): "Does child have physical, emotional, behavioral, or developmental condition that is expected to last >1 year? Does child take daily, prescribed medication other than vitamins? Is child unable to do things most children of same age can do? Does child need or receive [Early Intervention], special education, therapy such as physical, occupational, speech, or counseling?" Physicians and nurse practitioners at the participating clinics and 10 pediatric subspecialty clinics at the medical center were eligible to complete a pre-intervention survey.

2.2. Data sources

Demographic (age, gender, language, insurance) and visit (site, date) information was obtained from the medical center's registration system. Clinical data (CMC provider designation, diagnoses) were abstracted from the EHR. Vaccine data (type, date) were collected from the medical center's immunization registry, which automatically captures vaccinations at the medical center and affiliated clinics [30] and synchronizes with the New York Citywide Immunization Registry (CIR). Providers in New York City (NYC) are required to report doses given to children <19 years to CIR; [31] ≥95% of adolescents are currently captured in CIR [32]. Thus, this study included doses administered at study and non-study sites in NYC.

2.3. Intervention

Of the potentially eligible parents of 582 adolescents identified through review of clinic registration and EHR data and contacted (>99% via telephone) between July and November 2014, 416 (71.5%) unique eligible parents were enrolled (Fig. 1). Randomization was conducted in 4 consecutive cohorts, each separated by 3 weeks, between October and December 2014. Immediately before randomization, adolescent vaccination status was reviewed, and a test text message was sent. Parents whose adolescent did not require HPV (first dose), influenza, and PPSV (first dose) vaccines (n = 118), had an undeliverable test text message (n = 1), or requested to stop text messaging (n = 2) were excluded. The remaining parents (n = 295) were stratified by clinic site and needed vaccines of interest and randomized to receive plain *vs.* educational text message reminders using a 1:1 allocation and variable block lengths in random sequence. With this final sample size (n = 295), there was 80% power to detect a 15% difference between arms, allowing for 5% type I error. Study analysts were blinded to group assignments. A "usual care" (non-text message reminder) arm was not included given the anticipated sample size, study scope, and demonstrated effectiveness of text message reminders in our general patient population.

Up to 5 weekly automated text message reminders were sent in the parent's primary language (English/Spanish) between October 2014 and December 2015; 1–2 additional "booster" messages were sent in January 2015. Before sending each message, vaccination status was reviewed. Parents whose adolescent had received ≥1 needed vaccine of interest since the prior message were sent no further reminders. The educational reminders addressed infection risk, vaccine safety/efficacy, and physician recommendations. They included one interactive message where parents could text numbered response(s) to receive information on selected topic(s) via text message (Appendix B). Both arms received usual care in the clinic, including telephone appointment reminders.

2.4. Surveys

At trial enrollment, all study parents (n = 295) completed a survey addressing demographics, general vaccine beliefs, and text messaging use. Most (n = 232; 78.6%) completed additional items addressing vaccine-related knowledge, beliefs, and practices. Remaining parents declined or were not prompted (due to staff time constraints) to complete these items. Between April and June 2014, 183 eligible providers (32 from the 4 study sites; 151 from the 10 affiliated subspecialty clinics) were identified through administrative rosters and recruited via email to complete a web-based survey addressing demographics and vaccine-related

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