



Organizational correlates of adolescent immunization: Findings of a state-wide study of primary care clinics in North Carolina



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ABSTRACT

Objective: To analyze organizational correlates of immunization coverage among adolescents served by high-volume primary care providers in North Carolina.

Methods: We randomly selected 91 clinics with at least 200 active records for patients ages 11–18 in the North Carolina Immunization Registry. For the 105,121 adolescents served by these clinics, we obtained immunization status for 6 vaccines, including human papillomavirus (HPV) vaccine (females only); meningococcal conjugate; and tetanus, diphtheria, and pertussis booster (Tdap).

Results: Clinics specializing in pediatrics had higher coverage for meningococcal vaccine (OR = 1.79, 95% CI: 1.25–2.55), Tdap vaccine (OR = 1.22, 95% CI: 1.00–1.50), and childhood vaccines. However, pediatric clinics had lower coverage for HPV vaccine initiation (OR = 0.70, 95% CI: 0.52–0.94). Other correlates, which varied by vaccine, included policies related to vaccine documentation and the age at which clinics recommended vaccines.

Conclusion: Overall, adolescents were more likely to receive vaccines, except HPV vaccine, if they attended a pediatric clinic with supportive clinical policies.

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Vaccinating adolescents can reduce morbidity and mortality associated with several infectious diseases. In the United States, guidelines currently recommend administering three vaccines to children ages 11–12, with catch-up vaccination throughout adolescence: human papillomavirus (HPV) vaccine; meningococcal conjugate; and tetanus, diphtheria, and pertussis booster (Tdap) [1]. Despite this recommendation, uptake of adolescent vaccines remains uneven. In 2011, initiation of the three-dose HPV vaccine series was 53% for girls ages 13–17, and series completion was 35% [2]; initiation and completion for boys was much lower, 8% and <1% [3]. In the same year, uptake of meningococcal vaccine (for boys and girls) was 71% and uptake of Tdap vaccine was 78% [2]. Improving adolescent vaccination rates even further, particularly for HPV vaccine, is important for achieving population protection against vaccine-preventable diseases.

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While characteristics of individuals or families, such as income, race, and ethnicity, are associated with uptake of adolescent vaccines, characteristics of healthcare organizations are also important [2,4–6]. For example, clinics with specialties such as pediatrics may be better equipped to stock and administer adolescent vaccines given their focus on younger patients [7–9]. Previous research has demonstrated that vaccine coverage also varies based on characteristics such as clinic size [10], the racial composition of clinics' patient populations [8], and clinics' participation in publicly funded immunization programs [8,11].

Similarly, vaccination may be supported by organizational practices and policies [6,12]. For example, clinics that send immunizations reminders to patients (or their parents) achieve a 5–20% increase in vaccination coverage [13]. Having clinic-based systems in place to document vaccination is also associated with increased odds of adolescent vaccination [6,14,15]. Research is needed to better understand the relative importance of these organizational factors, particularly with regard to how the influence of these factors varies, if at all, by vaccine type [6].

We sought to assess the association of clinic characteristics with adolescents' immunization status by analyzing data on vaccine provision in North Carolina clinics. To further probe the importance of provider practices and policies, we also examined how these factors correlated with adolescents' immunization status. By investigating

organizational correlates of immunization, this study aims to inform healthcare quality improvement efforts to raise vaccine coverage levels among adolescents.

1. Methods

1.1. Participants and sampling

Using the North Carolina Immunization Registry, we randomly selected 91 primary care clinics that were high-volume adolescent vaccine providers, defined as having active records for at least 200 adolescent patients. We then randomly selected a subset of 61 of these clinics to survey about their practices and policies related to vaccination of adolescents (response rate: 100%). Inclusion criteria for this study included participation in the North Carolina Immunization Program, which includes Vaccines for Children (VFC), a federally funded program that provides free vaccines to children ages 18 and under who are uninsured, under-insured, Medicaid-insured, or American Indian/Alaska Native. Around 94% of the approximately 1300 public and private clinics that participate in the North Carolina Immunization Program use the Immunization Registry [16], which contains information on 54% of the population of adolescents in the state [17].

1.2. Measures

1.2.1. Vaccination coverage

The North Carolina Immunization Registry (NCIR) provided data on adolescents' immunization status for the full sample of 91 clinics. We gathered data on the numbers of patients in each clinic who had received: one and three doses of human papillomavirus (HPV) (female patients only); meningococcal conjugate; and tetanus, diphtheria, and pertussis booster (Tdap). We also assessed coverage with childhood vaccines: two doses of measles, mumps, and rubella (MMR); three doses of hepatitis B (HepB); and two doses of varicella.

1.2.2. Clinic characteristics

The Registry also provided data for all 91 clinics on the following organizational characteristics: clinic size, measured as thousands of active adolescent patients (log transformed in analyses); clinic specialty (pediatrics, family medicine, or other); ratio of female to male adolescent patients; and racial/ethnic composition of patient population. We also assessed VFC-participation via a count of instances in which patients qualified for the program because of insurance status or American Indian/Alaska Native ethnicity (log transformed in analyses).

1.2.3. Immunization practices and policies

One author (AD), who coordinates state-wide efforts to increase adolescent vaccination, invited each clinic's vaccine coordinator to complete a web-based survey on immunization practices and policies: use of a reminder/recall system; review of patients' immunization records at each visit; and policies about the age at which clinics recommend each adolescent vaccine (a continuous variable). The survey also assessed the timeliness of vaccination documentation in NCIR (document vaccination during the healthcare visit; at the end of the visit; at the close of business on the day of the visit; or at least every two weeks) and the number of computers available for documentation in the Immunization Registry (one computer per clinic with access to NCIR or more than one computer per clinic).

1.3. Data analysis

We examined characteristics of clinics and their patients using descriptive statistics. To better understand why some

Table 1
Characteristics of adolescents, ages 11–18.

	<i>n</i>	%
Sex		
Male	50,177	47.7%
Female	49,230	46.8%
Unknown	5714	5.4%
Race		
White	51,883	47.0%
Unknown	28,165	25.5%
African American or Black	27,551	25.0%
Asian	1301	1.2%
Other	904	0.8%
American Indian/Alaska Native	405	0.4%
Native Hawaiian/Pacific Islander	102	0.1%
Ethnicity		
Non-Hispanic	65,190	59.1%
Unknown	39,758	36.0%
Hispanic	5363	4.9%
Insurance type		
Patients who initiated VFC-eligibility, mean (SD)	632 (67)	

Note: The total number of individuals varies due to measurement at two different time points, approximately three months apart.

immunization records had incomplete data for patient demographics (sex, race, and ethnicity), we correlated clinics' rates of incompleteness with clinic characteristics and policies.

We analyzed clinic-level correlates of vaccination coverage separately for each vaccine. Using the full sample of 91 clinics, we assessed associations between immunization status and clinic characteristics using bivariate logistic regression that adjusted for clustering at the clinic level and weighted vaccination by the number of patients in the clinic. We entered statistically significant correlates into a multivariate logistic regression model, again accounting for clinic-level clustering and weighting. For the subset of 61 clinics reporting on immunization practices and policies, we again used bivariate and then multivariate logistic regression to evaluate the association with vaccination. We report odds ratios from bivariate analyses in tables, and odds ratios from multivariate analyses in text. For vaccines that had only one statistically significant bivariate correlate, the additional multivariate logistic regression was unnecessary.

We conducted a sensitivity analysis by examining correlates of immunization status for the adolescents in the target age range for adolescent vaccines (ages 11–12) and compared the results to those for the full sample (ages 11–18). Because of the lack of variability reported with regard to the practice of performing chart reviews to determine if patients need any immunizations (97% reported doing this at each visit), analyses did not include this variable. We used Stata Version 12.0 (Statacorp, College Station, TX), and all tests were two-tailed with a critical alpha of .05.

2. Results

2.1. Characteristics of patients and clinics

Most adolescent patients were white (47.0%) or African-American (25.0%), and 4.9% were Hispanic (Table 1). Adolescent patients were evenly split between males and females. Clinics had an average of 632 instances in which patients qualified for the VFC program. On average, clinics had 4745 patients with immunization registry records (almost all would have been children), of whom 1155 were adolescents ages 11–18 (Table 2). Clinic specialties were pediatrics (58%), family medicine (41%), and internal medicine (1%). In analyses, we combined family medicine and internal medicine clinics. There were no differences between pediatric and family medicine clinics on their characteristics or policies, except that on average, pediatric clinics were larger (number of adolescent

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