Vaccination Rates for Measles, Mumps, Rubella, and Influenza Among Children Presenting to a Pediatric Emergency Department in New York City

Philip Zachariah,^{1,2} Amanda Posner,¹ Melissa S. Stockwell,^{1,2,3} Peter S. Dayan,¹ F. Meredith Sonnett,¹ Philip L. Graham,^{1,2,4,5} and Lisa Saiman^{2,4}

¹Department of Pediatrics, Columbia University Medical Center, and ²Morgan Stanley Children's Hospital of New York–Presbyterian, Columbia University Medical Center, New York; ³Department of Population and Family Health, Columbia University Mailman School of Public Health, New York, New York; ⁴Department of Infection Prevention and Control and ⁵Division of Quality and Patient Safety, New York–Presbyterian Hospital, New York

Corresponding Author: Philip Zachariah, MD, Department of Pediatrics, Columbia University Medical Center, 622 West 168th Street, PH 4-474, New York, NY 10032. E-mail: pz2177@columbia.edu.

Received August 25, 2013; accepted December 12, 2013; electronically published February 20, 2014.

We compared measles, mumps, rubella (MMR), and influenza vaccination rates of children presenting to a Pediatric Emergency Department (PED) in New York City with rates from national assessments. MMR and influenza vaccination rates in this PED population were generally comparable to community rates, but lower than Healthy People 2020 targets.

Key words. children; Emergency Department; MMR vaccine.

INTRODUCTION

Measles was officially eliminated in the United States in 2000, through widespread adoption of the measles–mumps–rubella (MMR) vaccine. Nonetheless, imported cases of measles still occur in the United States and can result in sporadic cases as well as outbreaks [1]. These arise from a combination of exposure to affected index cases, inadequate vaccination in the exposed cohort, and a low index of suspicion for measles among many health-care providers [2]. In addition, influenza remains a substantial cause of yearly morbidity and occasional mortality in both adults and children [3].

The role of the Pediatric Emergency Department (PED) in infectious disease surveillance and mounting a response to a potential outbreak is recognized [4]. However, the vaccination status of children presenting to the PED has not been well described. This information could be used to help structure an outbreak response and/or inform the development of strategies to increase vaccination rates. Since increased PED utilization has been associated with lack of quality preventive care [5], which could include under-vaccination, we hypothesized that the vaccination rates for MMR and influenza would be lower among children presenting to the PED than those in community-based

surveys. We compared the reported vaccination rates in the PED population with vaccination estimates available in recent national, state, and city surveys [6, 7, 8].

METHODS

Study Design, Site, and Subjects

The study was conducted in 2 phases in the PED at Morgan Stanley Children's Hospital of New York–Presbyterian/Columbia University Medical Center located in the Washington Heights section of northern Manhattan. Our PED serves the local community, which is largely Latino, as well as children from a wider geographic area. The PED has 28 beds, is a major urban trauma center, and has approximately 60,000 annual admissions.

In the first phase, a convenience sample of the PED population was studied to determine the feasibility of using our hospital vaccination registry, EzVAC, which receives data from the New York Citywide Immunization Registry (CIR), to assess vaccination status in study subjects. New York City Public Health Law mandates that providers document all vaccinations in CIR that are administered to children under 19 years of age [9]. Eligible subjects included children between the ages of 6 months and 18 years, admitted to the PED between 7 AM and 12 PM

between November 8th and 11th, 2011, and assigned a nonsevere triage category of 3, 4, or 5. Parents provided written consent and children provided verbal assent (when appropriate) to allow the study team to review the subjects' vaccination records.

In the second phase, a retrospective review of MMR and influenza vaccinations was performed using our hospital vaccination registry. Eligible subjects included children presenting to the PED from January 1 to January 14, 2012 regardless of triage category. Children were excluded if they were <6 months or >18 years of age at the time of presentation to the PED or if they did not live in New York City. The institutional review board of Columbia University Medical Center approved this study.

Statistical Analysis

In phase 1, the percentage of children with vaccinations records in EzVAC was assessed. *A priori*, we decided that if >90% of enrolled subjects had EzVAC records, we would consider the hospital vaccination registry records to be sufficient for use in phase 2 analyses.

In phase 2, we first assessed timeliness of vaccination in the PED study population as per current Center for Disease Control and Prevention (CDC) recommendations (first dose of MMR by 15 months, second dose of MMR by 6 years, 1 dose of influenza vaccine after 6 months). In this analysis, we examined the percent of subjects 16 months–6 years of age and 16 months to <48 months who had at least 1 dose of MMR and the percent of subjects 48 months–6 years old who completed the recommended 2-dose series. We then compared vaccination rates in three specific age groups within the PED population to national, New York State, and New York City estimates available in the CDC's National Immunization Survey (2011) (i.e., 19–35-month-olds [5], the national survey of children entering kindergarten [2011], i.e., 5–6-year-olds [6], and the national survey of influenza vaccination rates [2010–2011], i.e., 6-month to 17-year-olds [7]). Influenza vaccinations received during the 2010–2011 season were used to allow direct comparison with the available survey estimates. Confidence intervals at the 95% level were calculated for rates. All analyses were performed using SAS Version 9.3, (SAS Institute Inc., Cary, NC).

RESULTS

Phase 1

In the first phase, 423 children were eligible to participate in this study. Overall, 151 (35.7%) participated as permitted by Emergency Department workflow priorities. In all, 142 (94.0%) had vaccinations recorded in the hospital vaccination registry. Of the 9 subjects without

vaccinations recorded, 8 lived in New York City. We therefore concluded that we could use EzVAC to assess vaccination status for phase 2.

Phase 2

In the second phase, 2120 children presented to the PED, of whom 1684 (79.4%) were eligible for inclusion (median age 4 years, 51% male). Among the ineligible patients, 177 (8.3%) were infants <6 months of age, 175 (8.3%) were >18 years of age, and 101 (4.8%) did not reside in New York City. The study sample was comparable to the total PED patient population in 2011 (median age 5 years, 51.9% male).

MMR Vaccination

When assessing timeliness of vaccination, among the 734 subjects 16 months–6 years of age, 87.7% had at least 1 dose of MMR. Furthermore, 86.4% (438/507) of subjects 16 months to <48 months old had received 1 dose of MMR. In subjects 48 months–6 years old, 18.5% (42/227) had received 1 dose or less, and 81.5% (185/227) had completed the recommended 2-dose series. Among the 696 subjects, >6 years–18 years of age, 538 (77.3%) had 2 doses, 44 (6.3%) had only 1 dose, and 114 (16.4%) had no doses recorded.

MMR vaccination rates in the PED population were compared to the estimates for 2 age groups derived from nationally conducted surveys. Among 264 subjects 19–35 months of age, 84.8% (95% CI 80.5, 89.1) had received 1 MMR dose compared with 91.6% (95% CI 91.2, 92.8) of children in this age group nationally; 91.0% (95% CI 88.2, 93.8) in New York State; and 91.5% (95% CI 87.9, 95.1) in New York City [5]. Among 110 subjects 5–6 years of age, 80.9% (95% CI 72.5, 87.5) had received 2 MMR doses compared with vaccination rates for children entering kindergarten in 2011 nationally (94.8%) and in New York State (96.9%) [6].

Influenza Vaccination

During the 2010–2011 season, 790 (46.9%) of eligible subjects had no doses of influenza vaccine recorded. In 988 children, 6–59 months of age, 52.8% (n = 522) had at least 1 dose of influenza vaccine recorded while 54.0% (n = 376) of the 696 children ≥6 years of age had at least 1 dose recorded. The rate of influenza vaccination in subjects 6 months–17 years of age was 53.3% (95% CI 50.9, 55.7), while the rate in this age group nationally was 49% (95% CI 47.7, 50.3), and in New York State was 51.4% (95% CI 47.0, 55.8) [7].

DISCUSSION

Achieving high MMR vaccination rates early in life, including >90% 1-dose rates in children 12–15 months of

age and >95% 2-dose rates among school-aged children, is essential to maintain measles elimination in the United States and is a Healthy People 2020 goal [10]. Clusters of nonvaccinated or undervaccinated children can lead to measles outbreaks in an otherwise highly immunized population [11]. Our study suggests that assessment of MMR vaccination status in the PED could be used to identify non- or undervaccinated children and potentially deliver catch-up vaccination in our community. The ED has been evaluated as a site to assess vaccination status and for vaccine delivery [12]; delayed vaccination status was determined using an institutional immunization registry, and caregiver willingness to receive catch-up vaccinations in the PED was documented. The current study further strengthens the role of PED, as we used a more comprehensive immunization registry readily accessible to PED care providers and assessed a larger sample of patients in an urban, underserved population.

Healthy People 2020 envisions $\geq 80\%$ influenza vaccination rates. Though our study demonstrates comparable rates in the study population and national surveys, influenza vaccination rates remains suboptimal. Previous work performed in the ambulatory care network affiliated with our hospital found that the vaccination rate for at least 1 dose of seasonal influenza vaccine during the 2009–2010 season was 65.9% (± 1.0) for 6–59-month-olds and 50.6% (± 0.7) for those 6 months–18 years [13]. This further confirms the need to develop strategies to improve vaccination rates for influenza.

In this study, we used an electronic hospital vaccination registry, which integrates our institutional records with a citywide registry enabling easy access to comprehensive immunization history through the PED Electronic Health Record (EHR). Connecting EHR with applicable immunization information systems is an objective under the Centers for Medicare and Medicaid Services meaningful use criteria for use of EHR systems [14]. Establishing such systems will optimize assessment of vaccination status in the busy clinical environment of a PED visit and should be encouraged.

The study had limitations. It was performed in a single PED in New York City primarily serving an urban, Latino population. Our hospital vaccination registry linked to CIR was the sole method used to assess vaccination status. In the first phase of this study, our low recruitment rate could have led to a biased assessment of CIR coverage, but in 2008, CIR was shown to capture 93% of vaccines distributed by the Vaccines for Children Program [15], comparable to our rate of 94%. Nonetheless, though providers are mandated by law to report all vaccinations, even those delivered outside their practices, vaccination status

could be under-reported, particularly for older children vaccinated in their countries of origin. We also underestimated the influenza vaccination rates for the youngest infants, as eligibility criteria did not include age during the 2010–2011 season. Compared to phase 1, which we used to assess the feasibility of using EzVAC, the study population in the second phase included higher triage severity and patients seen overnight, which could have introduced bias. However, to minimize bias that could arise if more subjects in phase 2 lived outside New York City (and had no vaccinations recorded in CIR), we restricted phase 2 eligibility to residents of New York City. Furthermore, it is unlikely that the proportion of subjects in phase 2 with contraindications to receiving vaccinations (e.g., primary immunodeficiency) would be large enough to create meaningful bias.

In conclusion, assessment of vaccination status using an electronic immunization registry in the PED can help identify unvaccinated or undervaccinated children with implications for outbreak control and catch-up vaccination strategies.

Acknowledgments

Potential conflicts of interest. All authors: No reported conflicts.

All authors have submitted the ICMJE Form for Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

References

- Centers for Disease Control and Prevention (CDC). Measles—United States, 2011. *MMWR Morb Mortal Wkly Rep* 2012; 61: 253–7.
- Centers for Disease Control and Prevention (CDC). Measles imported by returning U.S. travelers aged 6–23 months, 2001–2011. *MMWR Morb Mortal Wkly Rep* 2011; 60:397–400.
- Zhou H, Thompson WW, Viboud CG, et al. Hospitalizations associated with influenza and respiratory syncytial virus in the United States, 1993–2008. *Clin Infect Dis* 2012; 54:1427–36.
- Centers for Disease Control and Prevention (CDC). Measles outbreak associated with an arriving refugee—Los Angeles County, California, August–September 2011. *MMWR Morb Mortal Wkly Rep* 2012; 61:385–9.
- Brousseau DC, Hoffmann RG, Nattinger AB, Flores G, Zhang Y, Gorelick M. Quality of primary care and subsequent pediatric emergency department utilization. *Pediatrics* 2007; 119: 1131–8.
- Centers for Disease Control and Prevention (CDC). National and state vaccination rates among children aged 19–35 months—United States, 2010. *MMWR Morb Mortal Wkly Rep* 2011; 60: 1157–63.
- Centers for Disease Control and Prevention (CDC). Vaccination rates among children in kindergarten—United States, 2011–12 school year. *MMWR Morb Mortal Wkly Rep* 2012; 61: 647–52.
- Centers for Disease Control and Prevention (CDC). Interim results: State-specific influenza vaccination rates—United States,

- August 2010–February 2011. *MMWR Morb Mortal Wkly Rep* 2011; 60:737–43.
9. Public Health Law: Article 21, Title 6, Section 2168—Statewide Immunization Registry. http://www.health.ny.gov/regulations/public_health_law/section/2168/ Accessed August 3, 2013.
 10. Koh HK. A 2020 Vision for Healthy People. *N Engl J Med* 2010; 362:1653–6.
 11. Sugerman DE, Barskey AE, Delea MG, et al. Measles outbreak in a highly vaccinated population, San Diego, 2008: Role of the intentionally undervaccinated. *Pediatrics* 2010; 125:747–55.
 12. Olson JJ, Mannenbach MS, Moore BR, Smith VD, Rosekrans JAJacobson RM. A reexamination of the feasibility of the administration of routine childhood vaccines in emergency departments in the era of electronic vaccine registries. *Pediatr Emerg Care* 2005; 21:565–7.
 13. Stockwell MS, Martinez RA, Hofstetter A, Natarajan K, Vawdrey DK. Timeliness of 2009 H1N1 vaccine rates in a low-income pediatric and adolescent population. *Vaccine* 2013; 31:2103–7.
 14. Centers for Disease Control and Prevention. Meaningful use and immunization information systems. <http://www.cdc.gov/vaccines/programs/iis/meaningful-use/>. Accessed November 1, 2013.
 15. Metroka AE, Hansen MA, Papadouka V, Zucker JR. Using an immunization information system to improve accountability for vaccines distributed through the Vaccines for Children program in New York City, 2005–2008. *J Public Health Manag Pract* 2009; 15:E13–21.