Pertussis Resurgence and Vaccine Uptake: Implications for Reducing Vaccine Hesitancy

Previously controlled vaccine preventable diseases (VPDs) are in resurgence.\(^1,2\) To date, there have been 477 confirmed measles cases in the United States in 2014, the most in 18 years.\(^3\) In 2013 there were \(~25\,000\) pertussis cases in the United States. Vaccine refusal has been associated with outbreaks of invasive *Haemophilus influenzae* type b disease,\(^4\) varicella,\(^5\) pneumococcal disease,\(^6\) measles,\(^7\) and pertussis.\(^8\)–\(^12\)

Even while national and statewide immunization coverage remain high, rates of parents who refuse vaccines via nonmedical exemptions (NMEs) to school immunization requirements have been increasing.\(^13,14\) Furthermore, NMEs cluster geographically,\(^9,10\) leading to critical reductions in herd immunity and a perfect storm for sustained transmission, outbreaks, and increased risk of VPDs to both unvaccinated and vaccinated individuals.\(^7,8,10,15,16\)

Beyond active refusal, many parents are delaying vaccines and using “alternative immunization schedules” to spread out the number of vaccines given per visit or in infancy.\(^11\) Seventy-seven percent of parents of young children report concerns about vaccines, such as the number of vaccines or doses given simultaneously or before age two, what ingredients are contained in vaccines, or if there are associations with adverse outcomes such as autism and other chronic diseases.\(^18\) Some have gone so far as to identify a “vaccine crisis in confidence.”\(^19\)–\(^21\)

Parental vaccine decision-making is complex and associated with perceived susceptibility and severity of disease, safety, and effectiveness of vaccines and trust in health care providers and the government.\(^7,8,13,18,19,22–26\) A broad range of heuristics further influence these decisions, including a tendency to overestimate very rare but severe risks of adverse events, to prefer errors of omission over errors of commission (risks of not vaccinating versus risks of vaccinating), and to prefer natural (disease) risks over man-made risks (vaccines).\(^24,26\)

With these and undoubtedly other unidentified factors, parents decide to vaccinate, delay vaccination, or forego vaccination altogether, impacting their children as well as others, often the most vulnerable (those too young to be vaccinated or with severe medical conditions).

Historical experiences support the hypothesis that effective control of disease through vaccination results in decreased perceptions of susceptibility to VPDs and increased focus on real or perceived risks of vaccines. In turn, vaccine coverage decreases, followed by disease resurgence. Once risk becomes apparent again, coverage rebounds, although at the cost of unnecessary illness and death in the interim.\(^27\) This hypothesis is supported by experiences with pertussis in Japan, Sweden, and the United Kingdom in the late 1970s.\(^28\) Concerns about the safety and necessity of whole cell pertussis vaccines led to declining coverage, which led to subsequent resurgence of disease. This resurgence prompted development of acellular vaccines, which were widely adopted...
by most developed countries. Coverage quickly increased as did control of pertussis. Similarly, measles-mumps-rubella (MMR) vaccine coverage in the United Kingdom dropped as a result of concerns about the vaccine causing autism, resulting in major outbreaks of measles. Recent data from the United Kingdom suggest that MMR coverage rates may be rebounding in the youngest birth cohorts, but whether this is due to the recognition of Wakefield’s research as fraudulent,21 a resurging incidence of measles, or both is difficult to ascertain.

In this issue of Pediatrics, Wolf et al provide a much-needed first step in trying to evaluate this phenomenon in contemporary pertussis epidemiology. Their ecologic study uses the Washington State Immunization Information System to compare proportions of infants with \( \geq 1 \), \( \geq 2 \), or \( \geq 3 \) pertussis-containing vaccines at 3, 5, and 7 months of age before, during, and after an epidemiologically defined outbreak (October 2011 through December 2012) in an attempt to quantify what impact contemporary increases in pertussis incidence had on up-to-date pertussis immunization coverage. Although small increases were observed, they did not find statistically significant differences in statewide up-to-date coverage between either the preepidemic and epidemic periods (absolute difference: 2.1%; 95% confidence interval: −1.6 to 5.9) or between the epidemic and postepidemic periods (absolute difference: 0.2%; 95% confidence interval: −4.0 to 4.5). These data suggest that the model predicting an increase in coverage after resurgence in risk may not explain the Washington pertussis experience.

There are challenges in how the study measured both exposure (disease outbreaks) and outcome (pertussis immunization coverage). Defining the start of an outbreak in epidemiologic terms is clear-cut, yet defining when a parent becomes aware of increased disease risk is less so. Additionally, measuring pertussis coverage among infants may miss the impact of perceived risk of disease on vaccine refusal, which is better measured by rates of NMEs; those data were not available during this time period. Ideally, coverage changes during or after outbreaks should also be evaluated in older age groups, including children receiving booster doses, adolescents, and adults, especially parents/caregivers of infants. It is also important to understand how pertussis outbreaks might have influenced people along the spectrum of those who are hesitant. Did parents who might have previously chosen to exempt opt instead to delay? Did those who might have delayed until after the first year of life instead only delay by a few months? Importantly, this study could not evaluate reasons for missed doses.

Although an important first step in trying to better understand the impact of disease resurgence on vaccine acceptance, this work also highlights the difficulty of understanding the contributions of 1 factor in a complex situation and challenges us to continue researching what factors are at play. Media coverage, changing laws governing NMEs, and outbreaks in nearby states likely influence decision-making. Changing 1 of these factors while not addressing others may not have a large effect. The authors also observed differences at the county level, further underscoring the need to evaluate data such as these locally.

We must also consider the impact that these findings may have on our understanding of vaccine hesitancy if they hold true after additional studies are conducted. If increasing the risk of disease does not result in a return to higher vaccine acceptance, how will this impact the interventions we design to educate the public about the importance of immunization? A recent systematic review of interventions for reducing parental vaccine refusal and hesitancy found limited evidence to guide implementation of effective strategies.22 Appropriately designed, executed, and evaluated interventions to address this gap in knowledge need to be a very high public health priority.

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Jessica E. Atwell and Daniel A. Salmon
Pediatrics 2014;134:602; originally published online August 18, 2014; DOI: 10.1542/peds.2014-1883

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