

Are Vaccines and Autism Linked? Formulating and Evaluating Hypotheses

by

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Autism spectrum disorder (ASD) is a developmental disorder characterized by defects in social interactions and difficulty communicating with speech or written words. Symptoms typically only become apparent once a child is older than three years old, often following what appears to be normal early childhood development. This transition from a “normal” to a “socially impaired” child, who will fail to form emotional bonds with his or her parents, is often devastating to families. The rate of autism diagnosis in the United States has risen dramatically in recent years, from less than 1 in 1000 children in the mid-1990s to about 17 in 1000 children in 2014.¹ Greater awareness of the syndrome has led to better screening efforts by pediatricians, and children are now diagnosed younger than before, allowing for earlier interventions.

At the same time that there has been a rise in autism diagnoses, there has been an increase in the number of childhood vaccinations. Beginning with a polio vaccine in the mid-1950s, the numbers of required vaccinations (to attend public schools in New York) now also includes MMR (measles, mumps, rubella), Tdap (diphtheria and tetanus), pertussis (whooping cough), varicella (chickenpox), hepatitis B, and Hib (H. influenzae)², with many vaccines requiring multiple injections. These injections are given to healthy children, and many contain preservatives to prevent contamination by bacteria or molds. One preservative found in some vaccines is thimerosal, a compound that contains mercury, a metal known to cause neurological damage in high doses.

In 1998, a physician in the United Kingdom, Andrew Wakefield, published a study of 12 autistic children and linked the MMR vaccine to the onset of symptoms in 8 of the 12. The report generated instant controversy, owing to poor methodology, and a conflict of interest with Dr. Wakefield, who owned the patent for a potential replacement vaccine to the widely used MMR vaccine. However, a correlation was noted between overall numbers of vaccines that children were receiving and an increase in the diagnoses of autism.

As both the causes of autism and the reason for the rise in autism diagnoses were still unknown, two popular hypotheses were publically discussed.

Hypothesis 1: Mercury in thimerosal caused neurological damage in children, and is at least partly responsible for the increase in autism diagnoses.

Hypothesis 2: The rate of autism incidence is not increasing, only the rate of autism diagnoses, as greater awareness of the syndrome and increased screening of children yields more positive diagnoses of autism.

¹Hill, H.A. *et al.* 2018. Vaccination coverage among children aged 19–35 months: United States, 2017. *Morbidity and Mortality Weekly Report* 67(40): 1123–8. DOI: 10.15585/mmwr.mm6740a4.

²New York State Department of Health. 2019. School Vaccination Requirements. <https://www.health.ny.gov/prevention/immunization/schools/school_vaccines/>.

Questions

1. What are the observations that led to the generation of the above hypotheses?
2. Do both hypotheses make testable predictions? How could you test them?
3. Subsequent experiments, examining several million children, disproved a link between thimerosal and autism; in fact no link of any kind was found to exist between vaccination and autism. Dr. Wakefield was found to have fabricated data, his paper was retracted, and he lost his license to practice medicine in the UK. Does the falsification of Hypothesis 1 vindicate the supporters of Hypothesis 2?
4. Although thimerosal was found to have no connection to autism, it was removed from most childhood vaccines due to public pressure. While this put many concerned parents at ease, and from this, may have increased the rate of childhood vaccination, it decreased the shelf-life of the vaccine, making the vaccines more expensive to produce. Was the removal of thimerosal a good decision?
5. The fallout of these studies (evidence of fabrication from Dr. Wakefield, failure to replicate his findings in larger studies) has not convinced many anti-vaccination advocates, who suggested that the increase in the number of vaccines itself generates a causal link to autism. Is this a reasonable scientific hypothesis? Why or why not?
6. Dr. Wakefield had a financial interest in discrediting the current MMR vaccine and having it replaced with a vaccine he held a patent on. Pharmaceutical companies have a financial interest in convincing the public that the vaccines they produce are safe. Both advocates of vaccine safety and those who maintain there is a connection to autism are able to produce convincing-sounding arguments that seem to strongly support their side. How do you know whom to trust?