



Herd Immunity: Can Infectious Diseases be Prevented by High Vaccination Coverage?

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The frequent statement that high levels of vaccination prevent disease outbreaks is not accurate as **infectious diseases do in fact occur even in fully vaccinated populations** ^[1] **as well as individuals.** ^[2] (See **Table 1** for more examples)

The likely reason for this is that vaccines primarily stimulate humoral immunity (antibody-based or Th2 responses) while they have little or no effect on cellular immunity (cytotoxic T-cells, Th1 responses), which is absolutely crucial for protection against viral as well as some bacterial pathogens. ^[3]

This may be the reason why vaccine-induced immunities are transient, requiring booster shots; while naturally acquired immunity conferred by the cellular immune system tends to be permanent in the absence of vaccination.

Taken together, these observations may explain why outbreaks of allegedly vaccine-preventable diseases do occur in fully vaccinated populations and why, **immunity (or its absence) cannot be reliably determined by measuring antibody levels,** ^[4] which is the most common measure of vaccine efficacy in clinical trials. ^[5-7]

It should be noted that there is an instance where vaccinations can induce T-cell (Th1) responses. This is possible in the case of **repetitive immunizations with the same antigen** (i.e., closely spaced “booster shots”).

However, **the induction of such immune responses is deleterious as demonstrated by Tsumiyama et al.** ^[8] **who showed that CD4+ T cells from repeatedly-immunized mice acquire the ability to induce autoantibodies which result in autoimmune tissue injury akin to that seen in human autoimmune diseases.**

From these experiments Tsumiyama et al. ^[8] concluded that **systemic autoimmunity appears to be the inevitable consequence of over-stimulating the host’s immune ‘system’ by repeated immunization with antigen.**

Table 1. Reports of infectious disease outbreaks despite high vaccination coverage

Report	Journal	Reference #
<p>From December 9, 1983, to January 13, 1984, 21 cases of measles occurred in Sangamon County, Illinois... The outbreak involved 16 high school students, all of whom had histories of measles vaccination after 15 months of age... The affected high school had 276 students and was in the same building as a junior high school with 135 students. A review of health records in the high school showed that all 411 students had documentation of measles vaccination on or after the first birthday, in accordance with Illinois law. <u>This outbreak demonstrates that transmission of measles can occur within a school population with a documented immunization level of 100%.</u></p>	<p>MMWR Morb Mortal Wkly Rep. 1984; 33(24):349-51</p>	<p>[9]</p>
<p>During 2006, a total of 6584 confirmed and probable cases of mumps were reported to the Centers for Disease Control and Prevention...<u>College campuses with mumps outbreaks included ones with 77% to 97% of students having had 2 doses of a mumps vaccine.</u></p>	<p>Pediatr Infect Dis J. 2008; 27(10 Suppl):S75-9</p>	<p>[10]</p>
<p>The Czech republic has had a two dose MMR vaccination programme since 1987. The last outbreak of mumps was reported in 2002, but an increase in the number of mumps cases was observed in 2005, starting in October that year. In an 18 month period examined, 5,998 cases of mumps were notified, with a peak incidence in May of 2006. <u>The highest incidence rate was observed in those in the age group of 15 to 19 years, in which 87% of the cases had received two doses of mumps vaccine.</u></p>	<p>Euro Surveill. 2008;13(16)</p>	<p>[11]</p>
<p>Despite high levels of vaccination coverage against diphtheria, an ongoing outbreak of diphtheria has affected parts of the Russian Federation since 1990... <u>an estimated 90% of children were fully vaccinated with four or more doses of diphtheria toxoid by the time they entered school...</u>The outbreak described in this report illustrates that, <u>despite a high vaccination coverage rate among school-aged children, diphtheria can cause epidemic disease</u> in developed countries.</p>	<p>MMWR Morb Mortal Wkly Rep. 1993; 42(43):840-841, 847</p>	<p>[1]</p>
<p>From January, 1988, to March, 1989, a <u>widespread outbreak (118 cases) of poliomyelitis type 1 occurred in Oman</u>. Incidence of paralytic disease was highest in children younger than 2 years (87/100,000) <u>despite an immunisation programme that recently had raised coverage with 3 doses of oral poliovirus vaccine (OPV) among 12-month-old children from 67% to 87%.</u></p>	<p>Lancet 1991; 338 (8769): 715-720)</p>	<p>[71]</p>
<p>Subclinical measles infection in vaccinated seropositive individuals in arctic Greenland. <u>More than 90% of the total population was vaccinated and a 94-100% seroconversion was obtained.</u></p>	<p>Vaccine 1998; 7(4):345-8</p>	<p>[12]</p>
<p>"The rates of secondary immune response (SIR) and secondary vaccine failure (SVF) during a measles epidemic were evaluated...In conclusion, <u>neither prior vaccination nor detectable SIR ensures protective immunity.</u></p>	<p>J Clin Microbiol. 1992; 30(7): 1778-1782</p>	<p>[13]</p>
<p>Results from two independent studies that both showed children faced a substantially increased rate of pertussis infection 4 or more years out from their fifth and final childhood vaccination... <u>Recent surges in U.S. pertussis cases, which began in 2005, and then spiked even higher in 2010, implicated the acellular vaccine as the cause...It certainly caused the 2010 California epidemic, and it happened in Minnesota and Oregon, too. Waning immunity with acellular pertussis led to greater vulnerability in 7- to 10-year-olds...</u></p>	<p>Internal Medicine News. 22 Nov 2011</p>	<p>[14]</p>

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