

Advantages and disadvantages of vaccinations



**ASSIGN
BUSTER**

The natural world is home to a truly vast diversity of pathogenic microorganisms, which can cause a similarly diverse range of diseases in humans, other animals, and plants. The human immune system contains a sophisticated series of defences against such infections, and generally functions automatically to protect the body from the various microbial attacks it is subjected to every day.

Some diseases, however, are able to overpower the immune system, and subsequently causes serious illnesses that can lead to death or lifelong disability. Diseases of this sort have largely become the focus of research into vaccines, with a view to potentially eradicating such conditions from the human population.

Vaccines provide an inducible immunity to the target illnesses, and although the terms “vaccination” and “immunisation” are often used interchangeably, vaccines do not always provide true immunity to a condition; their effectiveness often varies substantially between individuals.

The first useful vaccine was developed following the chance observation that milk maids seemed to be virtually immune to smallpox, a debilitating and painful condition that was often fatal (Pearson, 1798). On the occasions when a milk maid actually contracted smallpox, the resulting illness was often far less severe and of much shorter duration than in patients who had not spent time around cattle. Soon, the connection was made between smallpox in humans and the bovine equivalent, cow pox, which although capable of infecting humans, presented very little in the way of disease risk. Benjamin Jesty and Edward Jenner independently began the process

of inoculation with pus from cow pox sores to prevent patients contracting smallpox (Hammarsten et al., 1979; Pead, 2003). The concept of inoculation against illness was not new at this time, rather it built upon the previous practice of variolation which had been introduced in the 1720s, a process involving inoculation with low doses of infected material in the hope of producing a mild infection which the patient could then develop immunity to. Hence, vaccination (from the Latin *Variolae vaccinae*, meaning smallpox of cow) was born. Despite there being several scientists working toward the goal of the development of an immunisation treatment, Jenner is generally credited with the invention of the vaccine because his work involved not only the initial inoculation, but went on to challenge the patients with subsequent exposure to variolous material (Jenner, 1798).

By 1840, the more dangerous practice of variolation was made illegal, and vaccination was provided on an optional basis free of charge under the Vaccination Act, and was subsequently made compulsory in 1853; this perceived incursion upon civil liberties gave rise to an anti-vaccination movement, which is largely similar today to its presentation in the 19th century (Wolfe and Sharp, 2002).

Following the introduction of the smallpox vaccine, the disease has been virtually eradicated, with the only known remaining micro-organisms of the species stored as laboratory samples (Pennington, 2003). Since the development of vaccines in common practice, many infectious and potentially dangerous conditions have seen dramatic decline in incidence.

In modern practice, vaccines consist of live organisms, subunits of organisms, modified exotoxins, or whole inactivated organisms. Live organisms are generally attenuated so as to prevent overt pathogenicity, instead resulting in a non-clinical self-limiting disease that is sufficient to trigger the immune response and generate lasting protection. As live vaccines are able to reproduce following administration, single doses can provide long-term immunity (Faden et al., 1993; Talaat et al., 2014). Inactivated vaccines usually consist of either killed pathogens or subunits and toxins that would be released by them. As these are unable to replicate following administration, repeated boosters are necessary to maintain immunity.

Any attempt to weigh the advantages and disadvantages of a medical treatment involves the consideration of the potential benefit to the patient against the potential risks. In the case of vaccines, the potential benefit is immunity to the relevant condition. The risks involved include infection, from the site of injection, allergies to any of the vaccine ingredients, or potential adverse effects of the vaccine itself.

In many cases where the parents refuse vaccination for their children, they do so with the child's best interests at heart, but in the absence of a full understanding of the advantages and disadvantages of the vaccine in question (Kennedy et al., 2005). The erroneous and subsequently withdrawn study that notes a correlation between vaccine uptake and autism has served to reduce vaccine uptake, despite repeated press releases and media campaigns aimed at education. Moreover, the incidence of autism, even among those considered high-risk (genetic disposition and older sibling with <https://assignbuster.com/advantages-and-disadvantages-of-vaccinations/>

autism) is not changed upon administration of the measles, mumps, and rubella (MMR) vaccine (DeStefano and Shimabukuro, 2019).

Parental vaccine refusal is a growing problem, which largely fall into four categories: personal or philosophical reasons, religious objections, safety concerns, and desire for further information. With the exception of religious concerns, the other reasons for refusal can likely be managed with increasing the education of the parents, and also improving healthcare professionals' understanding of the reasons for parental refusal (McKee and Bohannon, 2016). With respect to observant Muslims or Jews who are required to abstain from consuming pork products, scholars have largely allowed for the administration of vaccines containing pork derivatives. A 1995 meeting of Islamic scholars agreed that the transformation of pork products into gelatin alters them sufficiently to be exempt from their religious requirements. Similarly, as Jewish laws on pork consumption refer only to the oral route, vaccines, injections, creams, suppositories, and other medicines containing porcine-derived ingredients are permissible (" IAC EXPRESS – Issue #400," 2003).

Perhaps part of the problem lies in the visibility of the illnesses. Autism is something that many people are familiar with, whether they personally know someone on the autistic spectrum or they are simply aware of the condition through various media presentation. Similarly, anaphylactic reactions are seen with some regularity and are therefore in the public mind. Conditions such as measles or polio, however, are virtually invisible in the modern westernised world, making it perhaps difficult for parents to imagine the consequences of contracting the disease.

<https://assignbuster.com/advantages-and-disadvantages-of-vaccinations/>

Polio, or poliomyelitis, is a viral infection that largely results in respiratory tract symptoms, gastrointestinal disruption, and some flu-like symptoms. Many people with this mild form of polio go on to recover completely (Mueller et al., 2005). However, a small number of cases result in viral penetration of the central nervous system, producing lethargy and irritability which can sometimes go on to form a paralytic condition in which muscles become poorly controlled or even completely paralysed (Neumann, 2004). Patients with mild paralysis can usually recover their muscular function over the course of a few months, while others can go on to suffer life-long disability. If the paralysis affects the respiratory muscles, polio can be fatal (Goldberg, 2002).

Early attempts at development of passive immunisation through the use of direct infusion of poliovirus antibodies were promising, showing that likelihood of disease progression and overall disease severity could both be reduced (Hammon, 1955). However, supplies of the purified gamma globulin were limited, so widespread distribution was unfeasible (Rinaldo, 2005). Consequently, the research focus shifted to the development of a vaccine.

Interestingly, whilst polio is now vaccine-preventable, with hopes that the disease could even be eradicated, the incidence in non-polio acute flaccid paralysis (NPAFP) has surged in direct proportion to the uptake rates of the polio vaccine (Vashisht and Puliyel, 2012). NPAFP is clinically indistinguishable from polio-induced paralysis, but is considerably more deadly. Many thousands of individuals have developed NPAFP as reported by Vashisht and Pulivel (2012), but the association between the vaccine and the illness was reported even earlier during a Nigerian outbreak of

NPAFP (MacInnis, 2007). This deeply concerning observation brings the safety of the polio vaccine into question.

Although the example given above which describes the potential induction of a polio-like condition following the administration of a vaccine could be counted as an adverse reaction, another primary cause of concern is that vaccines are not perfect, and cannot always be relied upon to provide the immunity intended. Indeed, high school students in Maury County, Tennessee experienced an outbreak of mumps during 1991 in which over a thousand students were infected, yet all but one of them had been vaccinated against mumps (Briss et al., 1994). Of those who underwent subsequent serological testing, several completely lacked the necessary anti-mumps antibodies, indicating primary vaccine failure.

Incidences of widespread vaccine failure are relatively uncommon, and with generally high levels of vaccine uptake, those individuals for whom a vaccine is ineffective are protected through a mechanism referred to as herd immunity. In short, with the general population displaying immunity to a given infection, it can no longer be transmitted through that population. Consequently, individuals who might still be vulnerable to the pathogen are shielded from it by the immunity of the people around them (Garnett, 2005). The effect was initially observed in the 1920s and has subsequently led to mass vaccinations to induce herd immunity for a wide variety of infectious diseases (Fine et al., 2011).

Modern vaccine development has led to immunisation against the human papilloma virus (HPV), the organism responsible for the majority of cases of

cervical cancer (Kash et al., 2015; Marrazzo et al., 2001). This marks an important step because rather than producing a vaccine with the intention of preventing a simple infectious disease, the aim for this vaccine was to reduce the risks of cervical cancer. Indeed, the research towards a cancer vaccine has shown some hopeful results, with prostate-specific antigen (PSA) and the human epidermal growth factor receptor 2 (HER2) representing promising targets (Berzofsky et al., 2018).

As with many types of medical decision, the Hippocratic Oath comes into play: *Primum non nocere* (First, do no harm). Whilst arguably the rising incidence of NPAFP may be linked to the distribution of a polio vaccine, on the whole, vaccines present protection both at an individual level and for populations as a whole. As religious organisations provide exemption for their followers to use these products, and public education on the benefits of vaccination improves, it can be hoped that many of the diseases that afflict modern humans may someday be eradicated.

References

Berzofsky, J. A., Terabe, M., Trepel, J. B., Pastan, I., Stroncek, D. F., Morris, J. C., Wood, L. V., 2018. Cancer vaccine strategies: translation from mice to human clinical trials. *Cancer Immunol. Immunother.* CII 67, 1863–1869.

Briss, P. A., Fehrs, L. J., Parker, R. A., Wright, P. F., Sannella, E. C., Hutcheson, R. H., Schaffner, W., 1994. Sustained Transmission of Mumps in a Highly Vaccinated Population: Assessment of Primary Vaccine Failure and Waning Vaccine-Induced Immunity. *J. Infect. Dis.* 169, 77–82.

DeStefano, F., Shimabukuro, T. T., 2019. The MMR Vaccine and Autism. *Annu. Rev. Virol.*

Faden, H., Duffy, L., Sun, M., Shuff, C., 1993. Long-Term Immunity to Poliovirus in Children Immunized with Live Attenuated and Enhanced-Potency Inactivated Trivalent Poliovirus Vaccines. *J. Infect. Dis.* 168, 452–454.

Fine, P., Eames, K., Heymann, D. L., 2011. “Herd immunity”: a rough guide. *Clin. Infect. Dis. Off. Publ. Infect. Dis. Soc. Am.* 52, 911–916.

Garnett, G. P., 2005. Role of herd immunity in determining the effect of vaccines against sexually transmitted disease. *J. Infect. Dis.* 191 Suppl 1, S97-106.

Goldberg, A. I., 2002. Noninvasive mechanical ventilation at home: building upon the tradition. *Chest* 121, 321–324.

Hammarsten, J. F., Tattersall, W., Hammarsten, J. E., 1979. Who discovered smallpox vaccination? Edward Jenner or Benjamin Jesty? *Trans. Am. Clin. Climatol. Assoc.* 90, 44–55.

Hammon, W. M., 1955. Passive immunization against poliomyelitis. *Monogr. Ser. World Health Organ.* 26, 357–370.

IAC EXPRESS – Issue #400 [WWW Document], 2003. URL <http://www.immunize.org/genr.d/issue400.htm#n8> (accessed 7. 8. 19).

Jenner, E., 1798. An Inquiry into the Causes and Effects of the Variolae VaccinaeA Disease Discovered in Some of the Western Counties

<https://assignbuster.com/advantages-and-disadvantages-of-vaccinations/>

of England, Particularly Gloucestershire, and Known by the Name of the Cow Pox.

Kash, N., Lee, M. A., Kollipara, R., Downing, C., Guidry, J., Tyring, S. K., 2015. Safety and Efficacy Data on Vaccines and Immunization to Human Papillomavirus. *J. Clin. Med.* 4, 614–633.

Kennedy, A. M., Brown, C. J., Gust, D. A., 2005. Vaccine beliefs of parents who oppose compulsory vaccination. *Public Health Rep.* 120, 252–258.

MacInnis, L., 2007. Nigeria fights rare vaccine-derived polio outbreak. *Reuters*.

Marrazzo, J. M., Koutsky, L. A., Kiviat, N. B., Kuypers, J. M., Stine, K., 2001. Papanicolaou test screening and prevalence of genital human papillomavirus among women who have sex with women. *Am. J. Public Health* 91, 947–952.

McKee, C., Bohannon, K., 2016. Exploring the Reasons Behind Parental Refusal of Vaccines. *J. Pediatr. Pharmacol. Ther. JPPT* 21, 104–109.

Mueller, S., Wimmer, E., Cello, J., 2005. Poliovirus and poliomyelitis: a tale of guts, brains, and an accidental event. *Virus Res.* 111, 175–193.

Neumann, D. A., 2004. Polio: its impact on the people of the United States and the emerging profession of physical therapy. *J. Orthop. Sports Phys. Ther.* 34, 479–492.

Pead, P. J., 2003. Benjamin Jesty: new light in the dawn of vaccination. *Lancet Lond. Engl.* 362, 2104–2109.

<https://assignbuster.com/advantages-and-disadvantages-of-vaccinations/>

Pearson, G., 1798. An Inquiry concerning the history of the Cowpox: principally with a view to supersede and extinguish the smallpox. The British Library.

Pennington, H., 2003. Smallpox and bioterrorism. *Bull. World Health Organ.* 81, 762–767.

Rinaldo, C. R., 2005. Passive immunization against poliomyelitis: the Hammon gamma globulin field trials, 1951-1953. *Am. J. Public Health* 95, 790–799.

Talaat, K. R., Luke, C. J., Khurana, S., Manischewitz, J., King, L. R., McMahon, B. A., Karron, R. A., Lewis, K. D. C., Qin, J., Follmann, D. A., Golding, H., Neuzil, K. M., Subbarao, K., 2014. A Live Attenuated Influenza A(H5N1) Vaccine Induces Long-Term Immunity in the Absence of a Primary Antibody Response. *J. Infect. Dis.* 209, 1860–1869.

Vashisht, N., Puliyeel, J., 2012. Polio programme: let us declare victory and move on. *Indian J. Med. Ethics* 9, 114–117.

Wolfe, R. M., Sharp, L. K., 2002. Anti-vaccinationists past and present. *BMJ* 325, 430–432.