Vaccinations

Vaccination or immunization is the act of administration of a small amount of disease causing agents into individuals to help them develop resistance against the disease and stay protected from that disease. It is an effective way of eradicating infectious disease (caused by disease-causing microorganisms or pathogens) that can be spread directly or indirectly from one individual to another.

Impact of Vaccines

Polio is an example of an infectious disease that affects children under 5 years of age and can lead to paralysis and death. There is no cure for polio, but there is a vaccine for it. As a result of a global effort to vaccinate all children, the number of polio cases has decreased 99% since 1988, from an estimated 350,000 cases then to 37 cases in the year 2016 (WHO estimates). Recommended global childhood vaccination regimens have resulted in eradicating or dramatically decreasing the number of individuals who are affected or die due to many infectious disease that have been major health threats for centuries.

Vaccinations and Spread of Disease

Vaccinations prevent spread of disease in the following ways:

1) Vaccinations reduces the number of people who can act as carriers and prevent the spread of disease thereby reducing the disease rates (depends on Vaccination Rate) and

2) Vaccinations protect the vaccinated person from being affected by the disease (depends on Vaccination Effectiveness)

3) If a large proportion of the community is vaccinated, unvaccinated and susceptible individuals randomly spread in the community benefit from Herd Immunity or reduced risk of exposure to disease-causing microorganism(provided Vaccine Refusers do not form small pockets of unvaccinated and highly susceptible individuals like children, immune suppressed individuals and elderly in the community).

We will explain the three concepts below with the help of a network, where individual nodes represent an individual and the edges are connections between individuals.

Vaccination Rate

Vaccination rate or immunization coverage is the percentage of people who receive the vaccine in relation to the overall population. Higher the vaccination rate, lesser number of people in the community can acquire the disease or be a carrier for the disease-causing microorganism and not show symptoms (asymptomatic carrier), lesser disease rate and more people in the community are protected from the disease.

Vaccination Effectiveness

Vaccine effectiveness or vaccine efficacy is the percentage reduction in disease incidence in a vaccinated group of people compared to an unvaccinated group under optimal conditions. There are many factors that impact vaccine effectiveness, such as, age, health status, prior exposure to pathogenic microorganism, time since vaccination, mode of delivery of vaccine, type of vaccine (live vs attenuated), composition of adjuvants and match to the circulating strains of the pathogenic microorganism. Higher the vaccination effectiveness, higher the number of protected people in the community, lower the effectiveness, more number of people in the community are susceptible to the disease even if they had received the vaccine.

Vaccination Refusal

Individuals who fear the adverse effects of vaccinations, or have religious, philosophical objections or are allergic to a component of the vaccine choose not to get vaccinated and may also opt-out their children from receiving vaccinations. Small local communities of Vaccine refusers can result in clusters where opportunities of outbreak of vaccine-preventable disease can be high. They also break herd immunity, which is a form of indirect protection from infectious disease that occurs when large percentage of population is vaccinated and resistant to the disease thereby providing protection to individuals randomly distributed in the community who are susceptible. High proportion of vaccine refusal leads to higher number of susceptible individuals in the community.

Conclusion

From the past we learn that vaccination is a way to reduce spread of infectious disease. It is most effective when most people in the population receive it, when the vaccine efficacy is higher and when vaccine refusal is lowest. Vaccination is good for the self and also for more susceptible groups in the society such as infants, children, pregnant women, people with a suppressed immune system and elderly.

References

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Vaccination Game: <http://vax.herokuapp.com/game>

Inspiration: <https://jheer.github.io/barnes-hut/>

Related Information on Flu Vaccine from CDC:

<https://www.cdc.gov/flu/about/season/flu-season-2017-2018.htm>

On [February 15, 2018, CDC published interim VE estimate for the 2017-2018 U.S. flu season](https://www.cdc.gov/mmwr/volumes/67/wr/mm6706a1.htm?s_cid=mm6706a1_e). These estimates included data collected on 4,562 children and adults enrolled in the U.S. Flu VE Network during November 2, 2017 – February 3, 2018.  During this period, overall adjusted VE against influenza A and B was 36% (95% CI: 27% to 44%). This means overall the seasonal flu vaccine reduced the risk of getting sick and having to go to the doctor from flu by about one third. Influenza H3N2 viruses were responsible for most (69%) of the flu infections reported in this study, and as expected, at 25% (95% CI: 13%–36%), VE was lower against influenza A(H3N2) viruses. Of note, VE against H3N2 was high in children 6 months through 8 years of age [51% (95% CI: 29%–66%)]. This means the risk for H3N2 illness that required a doctor’s visit was reduced by more than half among this group of vaccinated children. VE against other flu viruses, including against influenza A(H1N1) and influenza B viruses, also was higher than against A(H3N2). VE was 67% (CI: 54%–76%) against influenza A(H1N1)pdm09 viruses and 42% (CI: 25%–56%) against influenza B viruses.

#### The interim vaccine effectiveness for children 9-17 years for 2017-2018 is listed as – 8 % effective? What does that mean? Did vaccination increase the risk of getting flu?

The negative point estimate cited is for interim flu vaccine effectiveness estimate against H3N2 viruses among children 9-17 years for the 2017-2018 season and is based on information collected through [February 3, 2018](https://www.cdc.gov/mmwr/volumes/67/wr/mm6706a2.htm?s_cid=mm6706a2_w%20). When interpreting the results it is important to look at both the point estimate (-8%) and the 95% confidence interval (-62% to 29). When the confidence interval crosses zero, as in this situation, it means that no vaccine effectiveness (VE) against medically attended illness could be measured.