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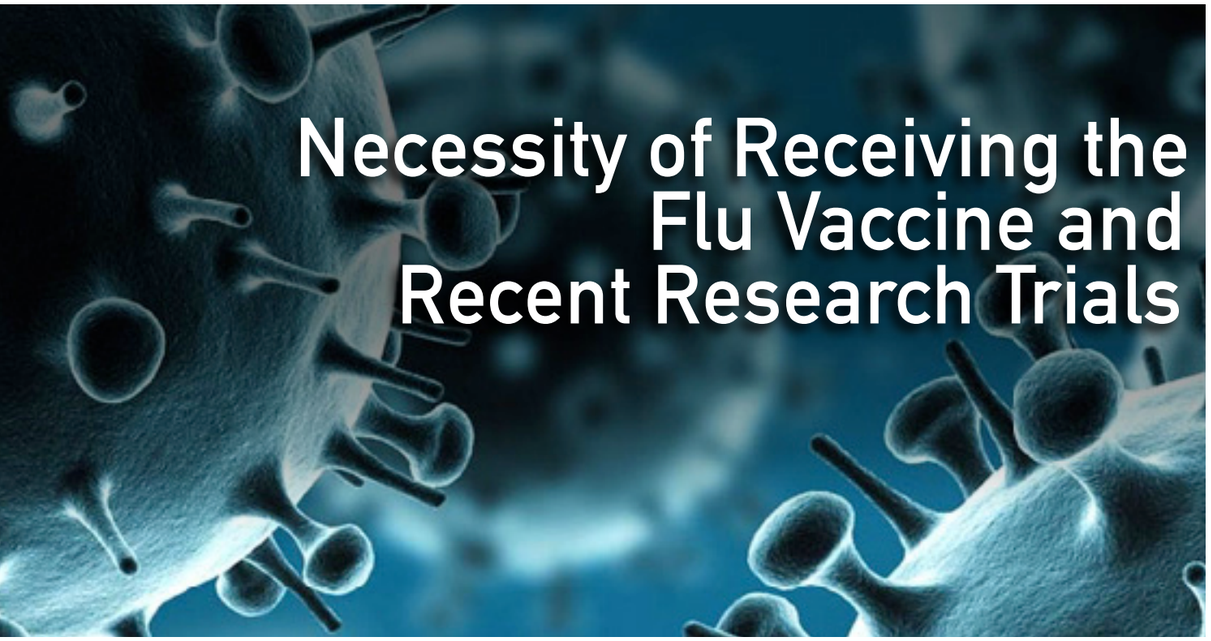

Necessity of Receiving the Flu Vaccine and Recent Research Trials

Lizzie Godschall

To this day, smallpox is the only disease confirmed to be eradicated worldwide. This would not have been possible without the first widely utilized vaccine developed nearly 200 years prior by Edward Jenner. Inspired by Jenner's methodology of using the cowpox virus to protect against smallpox in humans, vaccine innovations and their significance to public health took off after Louis Pasteur's discovery of the rabies vaccine in 1885. Vaccines are perhaps the greatest immunological feat to this day. So why are people still so averse to getting vaccinated, especially for the flu? Encouraging people to get their annual flu shot and persuading the public of its effectiveness are two vital measures for preventing flu-related hospitalizations and deaths.

Flu History

World War I played a significant role in the first influenza outbreak. The war brought the mass mobilization of over 60 million soldiers with significantly different backgrounds and immune systems to highly concentrated war zones in Europe. This, coupled with years of unsanitary lifestyles, facilitated high transmission rates leading to the H1N1 influenza pandemic outbreak in 1918 (Matthews, 2014). Over 50 million people died and many more were infected by the end of this pandemic. At the time, the only preventative measure that was exercised was quarantine.

About twenty years later, the influenza A and B viruses were isolated in the lab. Although vaccinations against this virus have been in development since the 1930's, numerous clinical trials have debunked the effectiveness of the influenza vaccine for decades after the 1918 pandemic (National Vaccine Information Center). A century after the first influenza outbreak, the CDC reported that the flu vaccine decreases the prevalence of flu related illness, hospitalization, and death, especially in young children and elderly people. Numerous studies have suggested that the trivalent influenza vaccine significantly reduces flu-related hospitalizations and fatalities (Nichols, 2018). The effectiveness of the flu vaccine varies from year to year depending on how well the projected vaccine antigen sequences matches the actual seasonal viral antigen. Although some years have better predictions than others, the overall effectiveness of the vaccine tends to be 40-60% (CDC).

Waves of first influenza outbreak 1918 (Potter, 2008)

What is the Flu Virus?

The influenza virus is characterized by two envelope proteins. Hemagglutinin (HA) is the protein that allows the virus to attach to host cells, while neuraminidases (NA) release the virus from the host cell (Morgridge). There are sixteen known types of hemagglutinin and nine known types of neuraminidase, which gives 144 different possible combinations of these proteins (Morgridge). Different viral strains contain distinct hemagglutinin and neuraminidase proteins, such as H1N1, the most common influenza A known as the "swine flu." Influenza vaccines contain three to four of the most common influenza strains, which are typically H1N1, H2N2, H2N3, and influenza B. The flu vaccine tends to be twice as effective in preventing H1N1 than H2N3 and influenza B (Rondy et al., 2018). This is one reason why the vaccine is not effective for everyone.

Why Do We Need the Flu Shot Every Year?

There is a need for a new vaccine every year due to antigenic drift. The antibodies that your body produced in response to last year's flu shot are specific to the viral antigens from that year's version of the vaccine. When a mutated version of that virus enters the body, these antibodies are no longer able to evoke an immune response (Potter, 2008). Since the virus mutates slightly each season, new vaccines with slightly different antigen combinations must be developed to recognize the hemagglutinin and neuraminidase proteins of the mutated virus. Once the vaccine is administered, your innate immune system will create a cascade effect to activate B-cells to produce antibodies. If you were to contract the influenza virus, ideally your body would already have the necessary antibodies to fight the virus and produce minimal flu-like symptoms. The vaccine enables our bodies to combat the virus by generating antibodies in advance. Within two weeks of vaccination, the adaptive immune system should have generated appropriate defenses against contracting the seasonal strain of the flu (CDC).

How Do I Choose a Vaccine?

The two most conventional types of flu vaccinations are egg based. These include the killed vaccine, taken as an intramuscular shot or live attenuated nasal spray vaccine (CDC). The killed vaccine involves injecting a fertilized hen egg with the influenza virus and later harvesting and purifying the viral fluid to acquire the inactivated viral antigen. The live attenuated vaccination is a weakened version of four common strains of live influenza viruses. This attenuated nasal spray is not recommended for people over 50 or immunodeficient recipients. Live attenuated vaccine is cold adapted, so the virus cannot survive and replicate in the warm environment of the lungs and cause an infection. Although vaccines are developed using viruses, the flu shot cannot cause the flu.

Innovations within the past five years include cell-based and recombinant technology (Nation Vaccine Information Center). The inactivated cell-based flu shot is produced in a similar way to the egg-based killed vaccine, but the viral antigen is extracted from a mammalian cell culture rather than utilizing chicken eggs. The recombinant vaccine requires isolating a gene expressing viral specific protein. Typically the gene encoding for HA is injected into an insect virus, so it can be replicated within insect cells. This process is faster than other methods because the virus does not need to undergo an attenuation phase to grow in eggs or cell cultures (CDC).

Recent Trials for Vaccine Development

Since the first influenza outbreak 100 years ago, a universal flu vaccine may become available in the near future. BiondVax's M-001 peptide vaccine has reached a phase 3 clinical trial in Europe. Instead of targeting the seasonally variable antigen surface of hemagglutinin and neuraminidase proteins, M-001 targets nine highly conserved epitopes of the flu virus. These epitopes, which are part of an antigen that are recognized by the immune system, don't change seasonally. So, ideally, you would only need one universal flu shot that would be effective for your lifetime. This approach allows for protection against all strains of influenza virus. Getting the universal vaccine in conjunction with the seasonal vaccine stimulates antibody production against hemagglutinin and has the most promising immunological success rate according to data acquired so far from the clinical trials (Taylor, 2018). About a dozen more influenza universal vaccines, each founded upon slightly modified approaches, are in the earlier stages of clinical trials. Increased public cooperation coupled with advancements in biomedical vaccination technology will hopefully lead to the stark decrease and eventual eradication of influenza viruses.

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Map - https://wol-prod-cdn.literatumonline.com/cms/attachment/ea27038e-7ecf-4133-8a70-3b26499dd67c/jam_1492_f3.gif

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