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Vaccinology and Vaccines in the 21st Century

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Vaccines are defined as biological agents that elicit an immune response to a specific antigen derived from infectious disease-causing pathogens. Pathogens are all around us and when they invade the body, they attack and multiply. This invasion, called an **infection**, is what causes illness. The immune system uses several tools to fight infection. Blood contains red blood cells, for carrying oxygen to tissues and organs, and white or immune cells, for fighting infection. Apart from the natural barriers which the body possesses, immune cells usually help in overcoming the infection by triggering immune responses.

A pathogen is a bacterium, virus, parasite or fungus that can cause disease within the body. Each pathogen is made up of several subparts, usually unique to that specific pathogen and the disease it causes. The subpart of a pathogen that causes the formation of antibodies is called an antigen. The antibodies produced in response to the pathogen's antigen are an important part of the immune system. We can consider antibodies as the soldiers in our body's defense system. Each antibody, or soldier, in our system is trained to recognize one specific antigen. We have thousands of different antibodies in our bodies. When the human body is exposed to an antigen for the first time, it takes time for the immune system to respond and produce antibodies specific to that antigen. In the meantime, the person is susceptible to becoming ill. Once the antigen-specific antibodies are produced, they work with the rest of the immune system to destroy the pathogen and stop the disease.

Vaccines contain weakened or inactive parts of a particular organism (antigen) that triggers an immune response within the body. Newer vaccines contain the blueprint for producing antigens rather than the antigen itself. Regardless of whether the vaccine is made up of the antigen itself or the blueprint so that the body will produce the antigen, this weakened version will not cause the disease in the person receiving the vaccine, but it will prompt their immune system to respond much as it would have on its first reaction to the actual pathogen. Some vaccines require multiple doses, given weeks or months apart. This is sometimes needed to allow the production of long-lived antibodies and development of memory cells. In this way, the body is trained to fight the specific disease-causing organism, building up memory of the pathogen so as to rapidly fight it if and when exposed in the future.

Vaccines have revolutionized global health, eradicating viruses like smallpox and nearly eliminating poliovirus - diseases that previously killed millions of people. The number of people who contract preventable infectious diseases like measles, diphtheria and whooping cough is at an all-time low. The first recorded attempts to induce immunity deliberately were performed by the Chinese and Turks in the 15th century. Reports suggest that the dried crusts derived from smallpox pustules were either inhaled into the nostrils or inserted into small cuts in the skin, a technique called **variolation**, in order to prevent this dreaded disease. The effectiveness of these early vaccination efforts is not well-known, but they had the right idea: taking a weaker version of the virus and introducing it to healthy people to allow their immune system to build up antibodies.

A more sophisticated take on vaccinations can be traced back to the late 18th century when the English physician Edward Jenner made a giant advance in the deliberate development of immunity. Intrigued by the fact that milkmaids who had contracted the mild disease cowpox were subsequently immune to the much more severe smallpox, Jenner inoculated an eight year old boy with fluids from a cowpox pustule and later intentionally infected the child with smallpox. As expected by him, the child did not develop smallpox. His method underwent medical and technological changes over the next 200 years, and eventually resulted in the eradication of smallpox.

Vaccines, like any medication, can cause side effects. The most common side effects are mild. However, many vaccine-preventable disease symptoms can be serious, or even deadly. Most side effects from vaccination are mild, such as soreness, swelling, or redness at the injection site. Some vaccines are associated with fever, rash, and achiness. Serious side effects are rare and side effect resulting from vaccination is known as an **adverse event**.

The COVID-19 pandemic, also known as coronavirus pandemic, is an ongoing global pandemic of coronavirus disease 2019 (COVID-19), which is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Apart from the economic and social disruption, Covid-19 has led to a dramatic loss of human life worldwide. Supportive care and vaccination is the only way forward considering the absence of specific, effective treatment or cure for COVID-19. There are strict procedures in place to help ensure the safety of all vaccines. Before receiving validation from WHO and national regulatory agencies, all vaccines including COVID-19 vaccines undergo rigorous testing in clinical trials to prove that they meet internationally agreed benchmarks for safety and efficacy. Unprecedented scientific collaborations have allowed COVID-19 vaccine

research, development, and authorizations to be completed in record time – to meet the urgent need for these vaccines while maintaining high safety standards.

Despite the evidence demonstrating the benefits of immunization both at the individual and community level are overwhelming, vaccines have always been met with some hesitation. While no vaccine is 100% effective, it is important to be aware that all vaccines are developed under stringent process which ensures efficiency and safety. The benefits of their use far outweigh any risks of side effects. Vaccine awareness is critical in maintaining the progress that has been made in reducing or eliminating many infectious diseases.

Total number of Participants – 75

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