A Brief History of the Vaccine World

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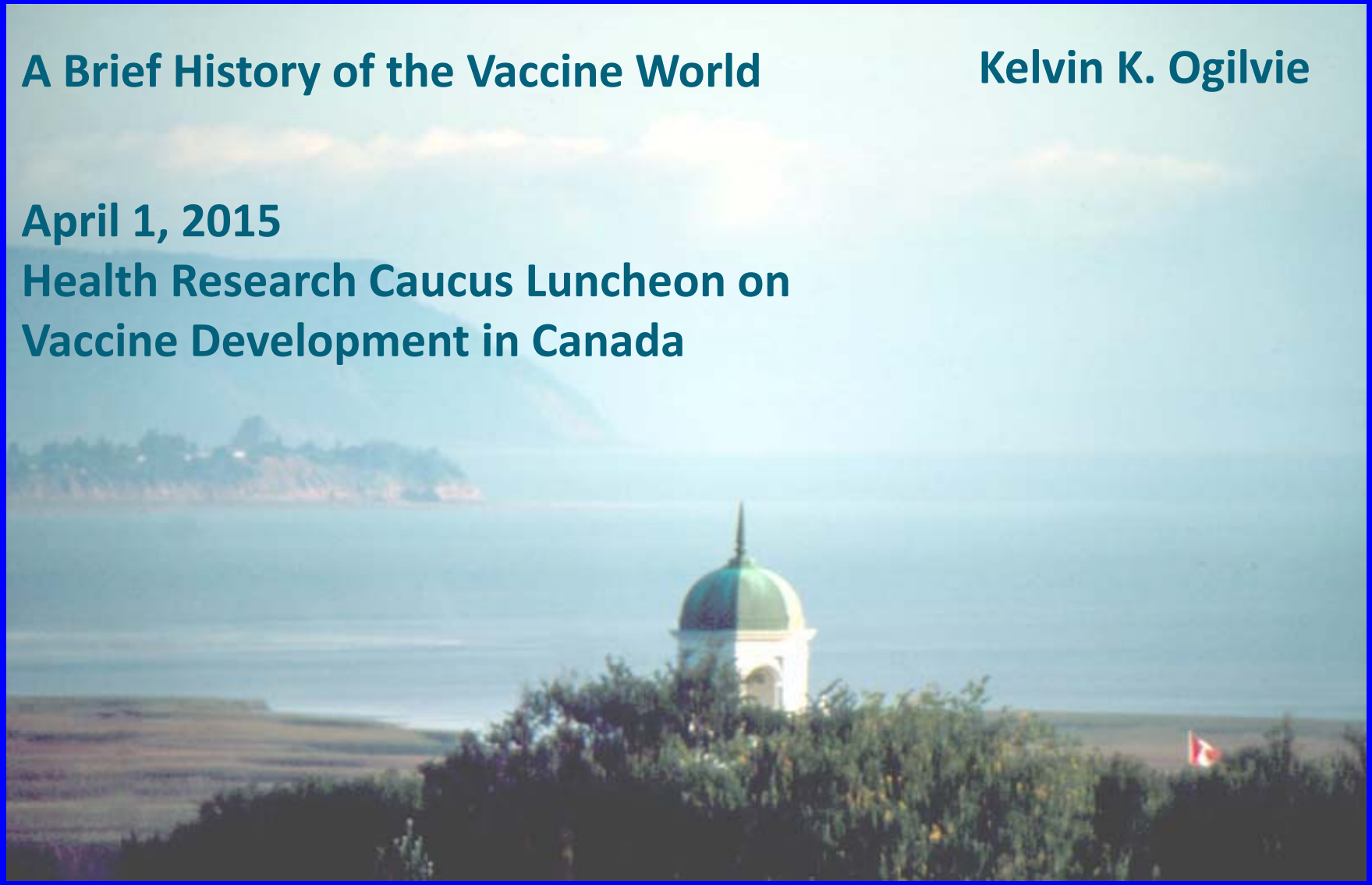

Definition of Vaccine

Variolae vaccinae (smallpox of the cow)

- A **vaccine** is a preparation (usually biological) that improves immunity to a particular disease.
- A vaccine typically contains an agent that resembles a disease-causing microorganism.
- **Vaccines are often made from weakened or killed forms of the microbe, its toxins or one of its surface proteins.**
- The agent stimulates the body's immune system to recognize the agent as foreign, destroy it, and keep a record of it, so that the immune system can more easily recognize and destroy any of these microorganisms that it later encounters.

History

Variolation: Transfer of live virus from patient to patient

- The Chinese practiced the oldest documented use of variolation, dating back to the fifteenth century.
- Their method consisted of blowing powdered smallpox material, usually scabs, up the nostrils.
- Mild smallpox cases were selected as donors. Scabs were left to dry out for some time, ground into powder or mixed with a grain of musk and bound in cotton.
- The material was then packed into a pipe and puffed up the patient's nostril. The right nostril was used for boys and the left for girls.

History

- In the 1700's rural legend had it that dairy workers would never have smallpox, because they had already had cowpox, which has a very mild effect in humans.
- In 1796, **Edward Jenner** took pus from the hand of a milkmaid with cowpox, scratched it into the arm of an 8-year-old boy, and six weeks later inoculated (variolated) the boy with smallpox, afterwards observing that he did not catch smallpox.
- Jenner extended his studies and in **1798** reported that his vaccine was safe in children and adults.

PASTEUR: 1880's

- The second generation of vaccines was introduced in the 1880s by Louis Pasteur who developed vaccines for chicken cholera and anthrax.

Both are bacteria

PASTEUR: 1880's

- His assistant, **Charles Chamberland,** ignored his instruction to inoculate chickens with a culture of chicken cholera. Instead he took a holiday and left the cultures alone for a month. On his return the culture of the bacteria failed to induce the disease in chickens.

- Pasteur discovered he could not infect these chickens, even with fresh bacteria.

- Pasteur concluded that the **weakened bacteria had caused the chickens to become immune** to the disease, and had caused only mild symptoms.

PASTEUR: 1880's

- Pasteur made an **anthrax vaccine** by exposing the bacilli to potassium dichromate, an oxidizing agent.

- He then used the weakened bacteria as a vaccine.

PASTEUR: 1880’s

- The anthrax and chicken cholera vaccinations were made from a weakened form of the disease organisms that had been "**generated artificially**".

- This discovery revolutionized work in infectious diseases, and Pasteur gave these artificially weakened diseases the generic name of "**vaccines**", in honour of Jenner's discovery.

- Pasteur produced the first vaccine for rabies by growing the virus in rabbits, and then weakening it by drying the affected nerve tissue.

TYPES of Vaccines

Inactivated:	Vaccines that contain inactivated, but previously virulent, micro-organisms that have been destroyed with chemicals, heat, radioactivity, or antibiotics. Examples are influenza, polio and rabies.
Attenuated:	Many of these are active viruses that have been cultivated under conditions that disable their virulent properties, or that use closely related but less dangerous organisms to produce a broad immune response. Most are viral (measles), some are bacterial (typhoid) in nature.
Toxoid:	Vaccines made from inactivated toxic compounds rather than the micro-organism. E.g. vs tetanus and diphtheria (both bacteria; toxin is a protein). Toxoid vaccines are known for their efficacy.
Subunit:	A fragment of a microorganism can create an immune response. Examples include the subunit vaccine against Hepatitis B and HPV.
Conjugate:	The linking of a bacterial polysaccharide outer coat to a protein. Used in the *Haemophilus influenzae* type B vaccine (misnamed).

TYPES (continued) - Experimental Vaccines

Dendritic cell (plus antigens) vaccines	Some positive preliminary results for treating brain tumors.
Recombinant Vector	Combines the physiology of one micro-organism and the DNA of the another, immunity can be created against diseases that have complex infection processes.
DNA vaccination	Created from an infectious agent's DNA. One advantage of DNA vaccines is that they are very easy to produce. DNA vaccination is still experimental.
T-cell receptor peptide vaccines:	Under development Synthetic vaccines are composed mainly or wholly of synthetic peptides, carbohydrates, or antigens.

TYPES (continued) Other

Valence

A monovalent vaccine is designed to immunize against a single antigen or single microorganism. A multivalent or polyvalent vaccine is designed to immunize against two or more strains of the same microorganism, or against two or more microorganisms.

Heterotypic

Also known as Heterologous or "Jennerian" vaccines these are vaccines that are pathogens of other animals that either do not cause disease or cause mild disease in the organism being treated. The classic example is Jenner's use of cowpox to protect against smallpox.

How They Work

- The immune system recognizes vaccine agents as foreign, destroys them, and "remembers" them.

- When the virulent version of an agent is encountered, the body recognizes the protein coat on the virus, and thus is prepared to respond, by:

  1. neutralizing the target agent before it can enter cells, and;
  2. recognizing and destroying infected cells before that agent can multiply to vast numbers.

Stages of Production

(one example)

1. Isolation of a single pure strain of a virus
2. Identification of a medium for the growth of a virus (animal blood proteins, fertilized eggs (influenza))
3. Growth and purification of a stable strain of the virus
4. Attenuation of the virus
5. Clinical trials
6. Approval

All steps in vaccine production are highly controlled under very stringent conditions and require well-trained technical personnel.


Thank You