

# Module 2: Vaccines and drugs: similarities and differences

Vaccine PV Fellowship  
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# Learning objectives

- At the end of this session, participants are expected to:
  - Know the peculiar features of vaccines and drugs
  - Know the similarities and differences between drugs and vaccines
  - Appreciate the need to take the similarities and differences between vaccines and drugs into consideration when undertaking vaccine pharmacovigilance

# Same, Similar or Different?

- Vaccine (vaccine product)
- Medicine
- Drug
- Pharmaceutical Product
- Biological Product
- Chemical Entity/New Chemical Entity

# What are vaccines?

- **Vaccine:** A product that stimulates a person's immune system to produce immunity to a specific disease, protecting the person from that disease
  - US CDC
- Vaccines are usually administered through needle injections, but can also be administered by mouth or sprayed into the nose

# Components of Vaccines

- The antigen (protein) – “active ingredient”
- Other chemicals used to make the vaccine product
  - Suspending fluid (sterile water, saline, or fluids containing protein)
  - Preservatives and stabilizers (for example, albumin, phenols, and glycine);
  - Adjuvants or enhancers that help improve the vaccine's effectiveness.
  - Very small amounts of the culture material used to grow the virus or bacteria used in the vaccine, such as chicken egg protein

# Exercise

- Do the components of vaccines have any bearings on the safety of the vaccine product?
- What likely safety issues are there with each of the vaccine components listed?

# Vaccine Components - I

- Aluminium gels or salts of aluminium
  - Added as adjuvants to help the vaccine stimulate a better response
  - Adjuvants help promote an earlier, more potent response, and more persistent immune response to vaccines
- Antibiotics
  - Added to some vaccines to prevent the growth of bacteria during production and storage of the vaccine
  - Penicillins are usually NOT USED in vaccines

# Vaccine Components - II

- Egg protein
  - Found in vaccines prepared using chicken eggs e.g. influenza and yellow fever vaccines
  - Could cause “egg allergy”
- Formaldehyde
  - Used to inactivate bacterial products for toxoid vaccines
  - Also used to kill unwanted viruses and bacteria that might contaminate the vaccine during production
  - Most formaldehyde is removed from the vaccine before it is packaged

# Vaccine Components - III

- Monosodium glutamate (MSG) and 2-phenoxy-ethanol
  - Used as stabilizers in a few vaccines to help the vaccine remain unchanged when the vaccine is exposed to heat, light, acidity, or humidity.
- Thimerosal
  - A mercury-containing preservative that is added to vials of vaccine that contain more than one dose to prevent contamination and growth of potentially harmful bacteria

# Drugs (Pharmaceutical Drug)

- Synonyms: medicinal product, medicine, medication, or medicament
  - A chemical, herbal or biological product used to diagnose, cure, treat, or prevent disease (EU)
  - Articles intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease in man or other animals OR Articles (other than food) intended to affect the structure or any function of the body of man or other animals (US)

# Drugs

- Drugs are classified in various ways
  - Legal/Regulatory e.g. OTC, P, POM etc.
  - Origin of the drug
  - Chemical/biological structure
  - Site/mode of action or therapeutic activity
- One of the most widely used systems is the Anatomical Therapeutic Chemical Classification System (ATC system)
  - Used widely by WHO and most global agencies

# ATC Codes

- J Anti-infectives for systemic use
  - J01 Antibacterials for systemic use
  - J02 Antimycotics for systemic use
  - J04 Antimycobacterials
  - J05 Antivirals for systemic use
  - J06 Immune sera and immunoglobulins
  - **J07 Vaccines**

# Classification based on origin

- **Drug from natural origin:** Herbal or plant or mineral origin, some drug substances are of marine origin.
- **Drug from chemical as well as natural origin:** Derived from partial herbal and partial chemical synthesis example steroidal drugs
- **Drug derived from chemical synthesis.**
- **Drug derived from animal origin:** For example, hormones, and enzymes.
- **Drug derived from microbial origin:** Antibiotics
- **Drug derived by biotechnology genetic-engineering, hybridoma technique for example**
- **Drug derived from radioactive substances**

# Drug Product

- In addition to the active ingredient, pharmaceutical drugs also contain
  - Additives e.g. binders (e.g. starch)
  - Lubricants (e.g. aluminium)
  - Disintegrants
  - Colorants
  - Sweeteners (liquid products)
  - Preservatives (parenteral preparations)
  - Others

# Exercise

- What likely safety issues are there with the additives for pharmaceutical drugs?
- What are the unique features of pharmaceutical drugs intended for
  - Parenteral use
  - Oral use
  - Topical use e.g. eye drops, nose drops, ear drops
  - Dermatological use

# Drugs versus medicinal products

- The term “drugs” has been used where there is a comparison between or reference to “vaccines” versus “drugs”, whereas “medicinal products” is used where the intention (i.e. meaning of the relevant text) is to cover vaccines and drugs in one term
  - CIOMS/WHO WG on Vaccine PV

# Vaccines and Drugs - Similarities

# Similarities between vaccines and drugs

- Vaccine are also medical products
- Vaccines, like drugs, can cause adverse events
- Vaccines and drugs all contain multiple ingredients
  - Each class of ingredient may cause their own adverse events
- Vaccines and drugs both have the potential for interaction with disease, drugs and other vaccines
- Vaccines and drugs all have to comply with standards of safety, quality and “efficacy”
  - Efficacy for medicines and protective efficacy for vaccines

# Differences - I

- Vaccines are almost always biological products
  - Subject to widespread variation even between batches
- Drugs may be chemical or biological
  - Chemical drugs have remarkable identity between batches and even between manufacturers
- All vaccines require special conditions of storage – usually cold storage
  - Chemical drugs do not usually require cold storage
  - Some biological drugs may require cold storage e.g. insulin

# Differences - II

- Vaccines are large molecules usually administered parenterally
  - Some vaccines may be given orally (e.g. polio vaccines) or intranasally
- Most chemical drugs are administered orally as tablets, capsules, suspensions etc..
  - Some drugs are given through various other routes e.g. IV, IM., SC, dermally etc.

# Differences - III

- Vaccines are normally given in “schedules” which must be adhered to
  - For whole populations and/or age groups
- Use of drugs is individualised
- Vaccines given mostly to PREVENT disease
- Drugs are given to treat, diagnose or prevent disease
- Vaccines are supposed to protect whole populations (“herd immunity”)
- Drugs are normally for the benefit of the individual

# Other Vaccine Specificities

# Number of Products and their storage

- About 40 vaccine antigens and associated products (individual antigens or combinations) compared with over 20 000 drugs
- Fewer vaccine manufacturers but more vaccine recipients
  - A single defective batch can therefore cause massive problems to populations
- Maintenance of the cold chain is essential for vaccines
  - Not so for chemical drugs
- Only few countries manufacture their own vaccines
  - Imported vaccines - long distance transport, cold chain issues etc.

# Vaccine Efficacy

- Vaccines are given to healthy individuals to prevent disease
  - Difficult to detect lack of efficacy
  - “Efficacy” based on the protection (immunity) offered
    - Difficult to assess immediately
- Vaccines may require repeated dosing to sustain protective efficacy
- Perceived need for a vaccine depends on disease burden
  - Herd immunity
  - Ultimate goal is disease eradication
- Different vaccine batches are similar but NOT identical
  - There is the need for batch data
  - Need for brand identity
  - Production process extremely important and with safety implications

# Vaccine Safety - I

- Low public tolerance for adverse events following immunization
- Adverse drug reactions are more common, less reported and more tolerated
  - Voluntariness of use increases the threshold for safety concerns
- Safety monitored by “promoters”
- Vaccines administered during “national immunization days”

# Vaccine Safety - II

- Causality assessment of adverse events to vaccines is difficult and require special expertise
- Lot-by-lot surveillance needed for vaccines
- Pharmacology of vaccines not always well understood
  - Ebola vaccine; Malaria vaccines; Newer vaccines
- Compensation plans for vaccines injury expected by recipients since vaccine usage is considered *mandatory*

# Exercise

- In view of their peculiarities, should adverse events to vaccines be monitored differently to those of drugs?
- Do vaccine adverse events require separate reporting forms?
- Compare and contrast unified vs. separate reporting systems for vaccines and drugs

# WHO Immunization coverage Fact sheet N°378

## Updated September 2015 Key facts

- Immunization prevents illness, disability and death from vaccine-preventable diseases including cervical cancer, diphtheria, hepatitis B, measles, mumps, pertussis (whooping cough), pneumonia, polio, rotavirus diarrhoea, rubella and tetanus
- Global vaccination coverage is generally holding steady.
- Uptake of new and underused vaccines is increasing.
- Immunization currently averts an estimated 2 to 3 million deaths every year
- But an estimated 18.7 million infants worldwide are still missing out on basic vaccines

**In addition to ACCESS issues, does safety have a role in immunization coverage?**

# Summary

- Vaccines and drugs are similar in several respects
- Vaccines and drugs have very important differences which have bearings on safety and safety monitoring
- Both unified and separate safety monitoring systems for vaccines and drugs exist in several countries
- Vaccine safety monitoring is critical in ensuring that the gains of immunization are sustained in the interest of public health and disease eradication which is the ultimate goal of all immunization programmes

# Comments, Questions etc.

