Communicable & Noncommunicable diseases, Epidemiology and prevention of EPI diseases, Chicken pox, Mumps

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Communicable diseases: Definition

- **Infectious diseases** are caused by invading organisms called pathogens.
- Infectious diseases **may or may not be contagious**.
- When an infectious disease is contagious, or capable of being communicated or transmitted, it is called a **communicable disease**.
- Examples of infectious communicable diseases are **HIV/AIDS, cholera, and influenza**.
- Although all communicable diseases are infectious diseases, not all infectious diseases are communicable diseases.

Communicable diseases: Definition

- An example of an **infectious noncommunicable disease is tetanus**, caused by the bacterium *Clostridium tetani*, which is found in the environment.
- Spores of the bacterium live in the soil, may remain infectious for more than 40 years, and are found throughout the world.
- Similarly, **anthrax exposure** may result by breathing spores that have been in the soil for, in some cases, many years.
- Another example is **Legionnaires' disease**, which is caused by inhaling *Legionella* bacteria from the environment.

Noncommunicable diseases: Definition

- Noncommunicable diseases (NCDs), also known as **chronic diseases**, tend to be of **long duration** and are the result of a **combination** of genetic, physiological, environmental and behavioural factors.
- Chronic conditions that do not result from **an (acute) infectious process** and hence are **"not communicable"**.
- A disease that has a **prolonged course**, that does not resolve **spontaneously**, and for which a complete cure is **rarely achieved**.

Noncommunicable diseases: Characteristics

- **Complex etiology (causes)**
- **Multiple risk factors**
- **Long latency period**
- **Non-contagious origin (noncommunicable)**
- **Prolonged course of illness**
- **Functional impairment or disability**

Types of Noncommunicable diseases

Major NCDs

- Cardiovascular diseases (Coronary heart diseases, Stroke)
- Cancer
- Chronic respiratory diseases
- Diabetes

Minor NCDs

- Mental illness
- Chronic neurologic disorders (Alzheimer's dementia)
- Musculoskeletal diseases
- Unintentional injuries and accidents (RTA)

Noncommunicable diseases: Risk factors

Non-modifiable

- Age,
- Gender,
- Race, and
- Family history (genetics)

Behavioural

- Physical inactivity,
- Tobacco use,
- Alcohol use, and
- Unhealthy diets

Metabolic

- Raised blood pressure
- Raised total cholesterol
- Elevated glucose
- Overweight and obesity

Environmental

- Indoor air pollution
- Outdoor air pollution

NCD: Common risk factors

Noncommunicable Diseases
4 Diseases, 4 Modifiable Shared Risk Factors

	Tobacco Use	Unhealthy diets	Physical Inactivity	Harmful Use of Alcohol
Cardio-vascular	✓	✓	✓	✓
Diabetes	✓	✓	✓	✓
Cancer	✓	✓	✓	✓
Chronic Respiratory	✓			

Noncommunicable Diseases
World Health Organization

World Health Organization

NCD: Global epidemiology

- **Noncommunicable diseases (NCDs)** killed at least **43 million** people in **2021**, equivalent to **75%** of non-pandemic-related deaths globally.
- In 2021, **18 million** people died from an NCD before age **70 years**; **82%** of these **premature deaths** occur in **low- and middle-income countries**.
- Of all NCD deaths, **73%** are in low- and middle-income countries.
- **Cardiovascular diseases** account for most NCD deaths, or at least **19 million** deaths in 2021, followed by cancers (**10 million**), chronic respiratory diseases (**4 million**), and diabetes (over **2 million**).
- These four groups of diseases account for **80%** of all premature NCD deaths.

National burden of NCD

- The **major NCDs contribute to 67%** of the total deaths in Bangladesh (NCD country profile 2018, WHO).
- Among these, cardiovascular diseases (**30%**), cancers (**12%**), chronic respiratory diseases (**10%**), diabetes (**3%**) are responsible.

National burden of NCD risk factors

According to National Noncommunicable Disease Risk Factors Survey in Bangladesh 2022 (**STEPS survey**) the prevalence of NCD risk factors:

- About **96.2%** of the people consumed less than the recommended minimum of **five servings of fruits and/or vegetables** per day
- About **19.5%** did not achieve the weekly-recommended **physical activity level** ($\geq$ 150 minutes per week)
- About **39.4%** consume **tobacco in any form** among whom **20.1% smoke tobacco and 24.8% use smokeless tobacco**

National burden of NCD risk factors

- **Hypertension** was prevalent in **23.5%** of the population
- About **28.9%** were **overweight** (BMI $\geq$ 25 kgm^2), and **5.2%** were **obese** (BMI $\geq$ 30 kgm^2)
- **Diabetes** was found in **9.7%** of the population

Gaps in natural history of NCD

- **Absence of a known agent**
- **Multifactorial causation**
- **Long latent period**
- **Indefinite onset**

Differences between communicable and noncommunicable diseases

Communicable diseases	Noncommunicable diseases
Spread from one person to another	Do not spread from one person to another
Always caused by pathogen	Usually not caused by pathogen
Short incubation period	Long incubation period
Short course of illness	Prolonged course of illness
Complete cure is possible	Complete cure is rarely possible
e.g. measles, chicken pox, covid-19	e.g. IHD, stroke, DM, COPD

Chicken pox

- **Chicken pox or varicella** is an acute, highly infectious disease caused by **varicella-zoster virus**.
- It is characterized by **vesicular rash** that may be accompanied by fever and malaise.
- Chicken pox transmitted from person to person by **droplet infection and by droplet nuclei**.
- Incubation period is usually **14-16 days**.

Clinical features of chicken pox

- Clinical course is divided into **two stages**:

❑ **Pre-eruptive stage:**
  - Onset is sudden with mild to moderate fever, pain in the back, shivering and malaise.
  - This stage is very brief, lasting about 24 hours.

❑ **Eruptive stage:**
  - **Distribution:** The rash is symmetrical. It first appears on the trunk where it is abundant, then comes on the face, arms and legs. Mucosal surfaces are generally involved. Palms and soles are not usually affected.

Clinical features of chicken pox

- **Eruptive stage:**
  - **Rapid evolution:** The rash advances quickly through the stages of macule, papule, vesicle and scab.
  - **Pleomorphism:** A characteristic feature of the rash in chickenpox is its pleomorphism, that is, all stages of the rash (papules, vesicles, crusts) may be seen simultaneously at one time, in the same area.
  - **Fever:** The fever does not run high but shows exacerbations with each fresh crop of eruption.

Differences between smallpox and chicken pox

Smallpox	Chickenpox
Incubation period	
About 12 days (7-17 days)	About 15 days (7-21 days)
Prodromal symptoms	
Severe	Usually mild
Distribution of rash	
Centrifugal	Centripetal
Palms and soles are frequently affected	Seldom affected
Axilla usually free	Axilla affected
Predominant on extensor surface	Predominant on flexor surface

Differences between smallpox and chicken pox

Smallpox	Chickenpox
Characteristics of the rash	
Deep-seated	Superficial
Vesicles multilocular and umbilicated	Uniocular; dew-drop like appearance
One stage of rash is seen at one time	Rash is pleomorphic
Inflammation is not seen around vesicles	Inflammation is seen around vesicles
Evolution of rash	
Evolution of rash slow, deliberate and majestic	Evolution of rash very rapid
Scabs begin to form 10-14 days	Scabs begin to form 4-7 days

Measles

- **Measles (rubeola)** is an acute highly infectious disease of childhood caused by a specific virus of the group **myxoviruses**.
- It is clinically characterized by fever and catarrhal symptoms of the **upper respiratory tract (coryza, cough)**, followed by a typical rash.
- Measles **occurs only in humans**.
- There is **no animal reservoir** of infection.
- Transmission occurs directly from person to person mainly by **droplet infection and droplet nuclei.**
- Incubation period is **commonly 10 days** from exposure to onset of fever, and 14 days to appearance of rash.

Clinical features of measles

- **Three stages** are seen in the natural history of measles:

❑ **Prodromal stage**

- It begins 10 days after infection, and lasts until day 14.
- It is characterized by fever, coryza with sneezing and nasal discharge, cough, redness of eyes, lacrimation and photophobia.
- A day or two before the appearance of rash **Koplik's spots** like table salt crystals appear on the buccal mucosa opposite the first and second **lower molar teeth**.
- These are small, bluish-white spots on a red base, smaller than the head of a pin. Their presence is **pathognomonic of measles**.

Clinical features of measles

❑ **Eruptive phase**

- This phase is characterized by a typical, dusky-red, macular or maculo-papular rash which begins behind the ears and spreads rapidly in a few hours over the face and neck, and extends down the body taking 2-3 days to progress to the lower extremities.
- In the absence of complications, the rash and fever disappear in another 3-4 days signaling the end of disease.

❑ **Post-measles stage**

- The child may have lost weight and will remain weak for few days.

Complications of measles

- Otitis media
- Laryngotracheo-bronchitis
- Diarrhoea
- Pneumonia
- Post-infectious measles encephalitis
- Sub-acute sclerosing panencephalitis (SSPE)
- Acute progressive encephalitis (measles inclusion-body encephalitis)
- Giant cell penumonia

Prevention of measles

- The following guidelines are important in combating measles:
  - **Achieving an immunization rate of over 95%**
  - **On-going immunization against measles** through successive generations of children

Rubella

- **Rubella or German measles** is an acute childhood infection, usually mild, of short duration and accompanied by **low-grade fever, lymphadenopathy and a maculopapular rash**.
- Infection in early pregnancy may result in **serious congenital defects**, including death of the foetus.
- Rubella is caused by an **RNA virus of the togavirus family**.
- The virus is transmitted directly from person to person by **droplets from nose and throat, and droplet nuclei**.
- There is also **vertical transmission** leading to congenital rubella in the newborn.

Clinical features of rubella

- **Prodromal symptoms:**
  - Coryza, sore throat, low-grade fever
- **Lymphadenopathy:**
  - Enlargement of the post-auricular, occipital and posterior cervical lymph nodes.
- **Rash:**
  - Minute, discrete, pinkish, macular rash appears first on the face.
- **Complications:**
  - Polyarthralgia, encephalitis, thrombocytopenic purpura

Congenita Rubella Syndrome (CRS)

- Congenital defects associated with CRS include:
  - **Ophthalmic:** cataract, microphthalmia, glaucoma, pigmentary retinopathy, chorioretinitis
  - **Auditory:** sensorineural deafness
  - **Cardiac:** peripheral pulmonary artery stenosis, patent ductus arteriosus or ventricular septal defects
  - **Craniofacial:** microcephaly
  - **Others:** meningoencephalitis, hepatospleenomegaly, hepatitis, thrombocytopenia, interstitial pneumonitis and radiolucency in long bones

Mumps

- An acute infectious disease caused by an **RNA virus of the family paramyxoviridae** which has a predilection for glandular and nervous tissues.
- Clinically, the disease is recognized by **non-suppurative enlargement and tenderness** of one or both the **parotid glands**.
- The disease is transmitted mainly by **droplet infection and after direct contact** with an infected person.
- Incubation period is usually **14-18 days**.

Complications of mumps

- **Frequent complications:**
  - Orchitis
  - Ovaritis
  - Pancreatitis
  - Meningoencephalitis
  - Thyroiditis
  - Neuritis
  - Hepatitis
  - Myocarditis
- **Rarer complications:**
  - Nerve deafness
  - Polyarthritis
  - Hydrocephalus
  - Encephalitis
  - Cerebellar ataxia
  - Facial palsy
  - Transverse myelitis

Mumps surveillance

WHO recommends the following case definitions for mumps surveillance:

- **Clinical mumps:** Acute onset of unilateral or bilateral tender, self-limited swelling of the parotid or other salivary gland, lasting 2 or more days and without the apparent cause
- **Laboratory confirmed mumps:** A patient with clinical mumps and laboratory confirmation by positive-mumps IgM antibody or sero-conversion with 4-fold or greater rise in mumps IgG titre or isolation of mumps virus from saliva, urine or CSF
- **Epidemiologically confirmed mumps:** A patient with clinical mumps who is epidemiologically linked to a laboratory-confirmed case.

Diphtheria

- Diphtheria is an acute bacterial infectious disease caused by toxigenic strains of **Corynebacterium diphtheriae**.
- The bacilli multiply locally, usually in the throat and responsible for:
  - The **formation of a greyish or yellowish membrane** (false membrane) commonly over the tonsils, pharynx or larynx
  - Marked **congestion, oedema or local tissue destruction**
  - Enlargement of the **regional lymph nodes** and
  - Sign and symptoms of toxemia

Mode of transmission of diphtheria

- The disease is spread mainly by **droplet infection**.
- It can also be transmitted directly to susceptible persons from **infected cutaneous lesions**.
- Portal of entry is of two route:
  - **Respiratory route**
  - **Non-respiratory route**
- Incubation period is **2-6 days**

Control of diphtheria

- **Cases and carriers:**
  - Early detection, isolation and treatment
- **Contacts:**
  - Contacts should be placed under medical surveillance and examined daily for evidence of diphtheria for at least a week after exposure.
- **Community:**
  - The only effective control is by active immunization with diphtheria toxoid.

Whooping cough (Pertussis)

- An acute infectious disease, usually of young children, caused by **Bordetella pertussis.**
- It is clinically characterized by an insidious onset with mild fever and an irritating cough, gradually becoming paroxysmal with characteristic **"whoop" (loud crowing inspiration)** often with cyanosis and vomiting.
- The Chinese call it a **"Hundred day cough".**
- Whooping cough is spread mainly by **droplet infection and direct contact**.
- Incubation period is usually **7-14 days**.

Control of whooping cough

- **Cases and carriers:**
  - Early detection, isolation and treatment
- **Contacts:**
  - Contacts should be given prophylactic antibiotic for 10 days.
- **Community:**
  - Active and passive immunization.

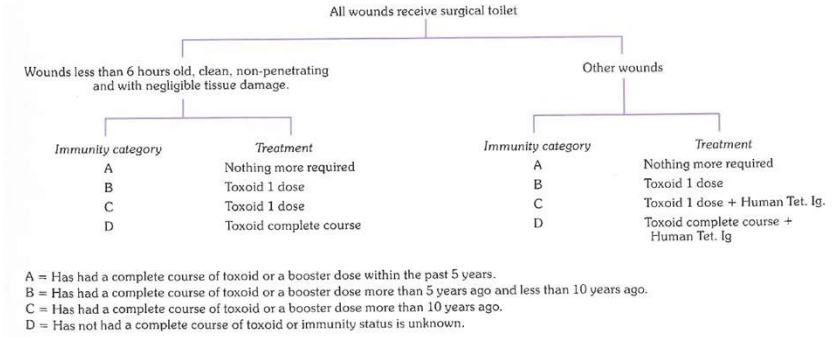
Tetanus

- An acute disease caused by the exotoxin of **Clostridium tetani** characterized bymuscular rigidity which persists throughout illness punctuated by painful paroxysmal spasms of voluntary muscles, specially-
  a. **Masseters (trismus or lock jaw)**
  b. **Facial muscles (risus sardonicus)**
  c. **Muscles of the back and neck (opisthotonus)**
- Infection is acquired by contamination of wounds with tetanus spores.

Prevention of tetanus

- Active immunization: **Tetanus toxoid**
  - Combined vaccine: **DPT, Td**
  - Monovalent vaccine
- Passive immunization: **Tetanus Immunoglobulin**
- Active and passive immunization
- Antibiotics

Prevention of tetanus after injury



A = Has had a complete course of toxoid or a booster dose within the past 5 years.
B = Has had a complete course of toxoid or a booster dose more than 5 years ago and less than 10 years ago.
C = Has had a complete course of toxoid or a booster dose more than 10 years ago.
D = Has not had a complete course of toxoid or immunity status is unknown.

Poliomyelitis

- Poliomyelitis is an acute viral infection caused by an **RNA virus**.
- It is primarily an infection of the **human alimentary tract** but may affect the **central nervous system**.
- Poliovirus has **three serotypes- 1,2 & 3**.
- Most outbreaks of **paralytic polio are due to type-1 virus**.
- **Man** is the **only known reservoir** of infection.
- Incubation period is **7 to 14 days**.

Poliomyelitis

- Polio is more likely to occur during the **rainy season**.
- Environmental sources of infection are **contaminated water, foods and flies**.
- **Mode of transmission:**
  - **Faecal-oral route:** Infection may spread directly through contaminated fingers or indirectly through contaminated water, milk, food, flies and articles of daily use.
  - **Droplet infection:** When virus occurs in the throat. Close contact with an infected person facilitates droplet spread.

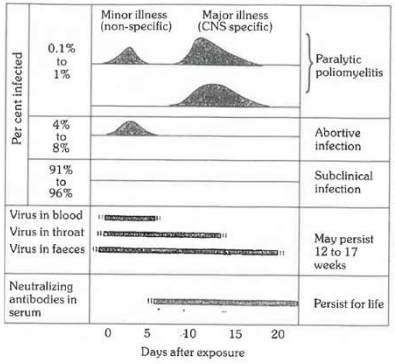
Clinical spectrum of poliomyelitis

- **Inapparent (subclinical) infection:** This occurs approximately 91-96% of poliovirus infections.
- **Abortive polio or minor illness:** Occurs in approximately 4-8% of poliovirus infections. It causes only a mild or self-limiting illness due to viraemia.
- **Non-paralytic polio:** Occurs in approximately 1% of all infections. The presenting features are stiffness and pain in the neck and back. The disease is synonymous with aseptic meningitis.
- **Paralytic polio:** Occurs less than 1% of infections. The virus invades CNS and causes varying degrees of paralysis.

Clinical spectrum of poliomyelitis

- **Paralytic polio:**
- The predominant sign is asymmetrical flaccid paralysis.
- A history of fever at the onset of paralysis is suggestive of polio.
- Other symptoms are malaise, anorexia, nausea, vomiting, headache, sore throat, constipation and abdominal pain.
- There may be signs of meningeal irritation i.e. stiffness of neck and back muscles.
- The paralysis is characterized as descending i.e. starting at the hip and then moving down to the distal parts of the extremity.

Time course of events in poliomyelitis



Poliomyelitis surveillance

- Surveillance is the most important part of the whole polio eradication initiative.
- Surveillance identifies the new cases and detects importation of wild poliovirus.
- **Acute flaccid paralysis surveillance:** There are 4 steps-
  - **Finding and reporting children with acute flaccid paralysis**
  - **Transporting stool samples for analysis**
  - **Isolating poliovirus**
  - **Mapping the virus**

Poliomyelitis surveillance

- **Environmental surveillance:**
- Environmental surveillance involves testing sewage or other environmental samples for the presence of poliovirus.
- Environmental surveillance often confirms wild poliovirus infections in the absence of cases of paralysis.

Vaccine derived poliovirus (VDPV)

- Although OPV is a safe vaccine, on rare occasions **adverse events may occur.**
- **Vaccine-associated paralytic poliomyelitis (VAPP)** is the most important of these rare adverse events.
- Cases of VAPPs ae clinically indistinguishable from poliomyelitis caused by **WPV**, but can be **distinguished by laboratory analysis**.
- The incidence of VAAP has been estimated at **4 cases/10 lac birth** cohort per year in countries using OPV.

Vaccine derived poliovirus (VDPV)

- VDPVs are divided into three categories:
  - **Community VDPVs (cVDPVs):** evidence of person-to-person transmission in the community.
  - **Immunodeficiency-associated VDPVs (iVDPVs):** isolates from persons with primary immunodeficiencies.
  - **Ambiguous VDPVs (aVDPVs):** Which are either clinical isolates from person with no known immunodeficiency or sewage isolates whose source is unknown.

Prevention of poliomyelitis

- Immunization is the **sole effective means** of preventing poliomyelitis.
- Both **killed and live attenuated vaccines** are available.
- It is essential to immunize all **infants by 6 months of age** to protect them against polio.
- Two types of vaccines are used throughout the world. These are:
  - **Inactivated (Salk) polio vaccine (IPV)**
  - **Oral (Sabin) polio vaccine (OPV)**

Differences between IPV and OPV

IPV	OPV
Killed virus	Live attenuated virus
Given subcutaneously or IM	Given orally
Induces only humoral immunity	Induces both humoral and intestinal immunity
Not useful in controlling epidemics	Effective in controlling epidemics
More difficult to manufacture	Easy to manufacture
Costlier	Cheaper
Does not require sub-zero temperature during storage and transportation	Requires to be stored and transported at sub-zero temperature

Why global polio vaccine switch from tOPV to bOVP?

- The **oral polio vaccine switch** is a globally synchronized event and a critical step towards polio eradication.
- It involves **replacing the trivalent oral polio vaccine** (tOPV), which protects against **three type of poliovirus (types 1, 2 and 3)**, with a new **bivalent vaccine** (bOPV) that will provide greater immunity against **two types of polio (types 1 and 3)**.
- Use of tOPV led to the successful eradication of **type 2 poliovirus** from the world in **1999**.

Why global polio vaccine switch from tOPV to bOVP?

- In rare cases, in areas with low routine tOPV coverage, the 'type 2' component of **tOPV can still cause vaccine-derived poliomyelitis**, which can cause **paralysis**, the same way that wild polio virus does.
- Therefore, to fully eradicate polio, all oral polio vaccines will be phased out entirely.
- This started with the removal of the type 2 component of tOPV, and a switch from **tOPV to bOPV in April 2016**.
- In the future, **bOPV** will also be phased-out and **only inactivated polio** vaccine will be used.

Use of fractional-dose inactivated polio vaccine (fIPV)

- **fIPV** is the **one-fifth** of full dose IPV.
- fIPV (0.1 ml) has **2 doses** given on 6 week and 14 week but full dose IPV (0.5 ml) was given 1 dose at 14 week.
- Due to scarcity of IPV vaccine, 2 doses fractional IPV is being given **intradermally** instead of 1 dose full IPV in intramuscular route.
- Research findings shows that, 2 doses **fIPV produce more immunity** than 1 dose full IPV vaccine.

Achievement of Bangladesh in eliminating poliomyelitis

- From **1995**, Bangladesh started to conduct **National Immunization Day (NID) to eradicate polio**.
- Between **1995 and 2014**, **21 NIDs** were successfully conducted in Bangladesh during which nearly 1 billion doses of oral polio vaccine (OPV) were administered to children under the age of **5 years**.
- Last case of wild **poliovirus** was detected in **2006** and maintains polio free since then.
- In **2014**, Bangladesh was declared a **polio free country** by the regional certification committee of WHO South East Asia Regional office.

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