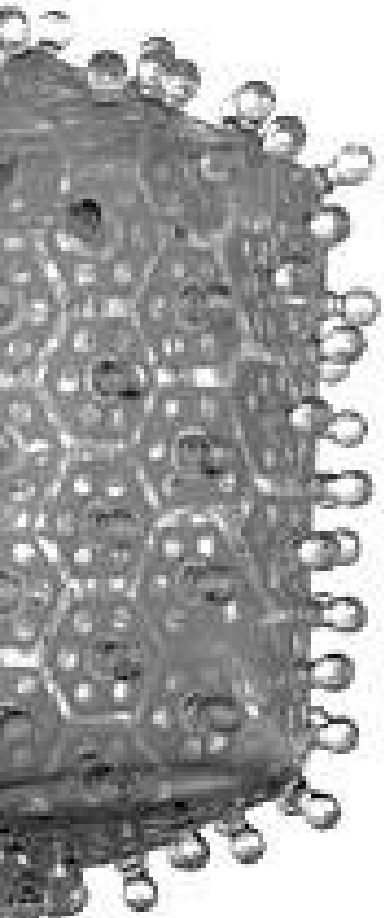
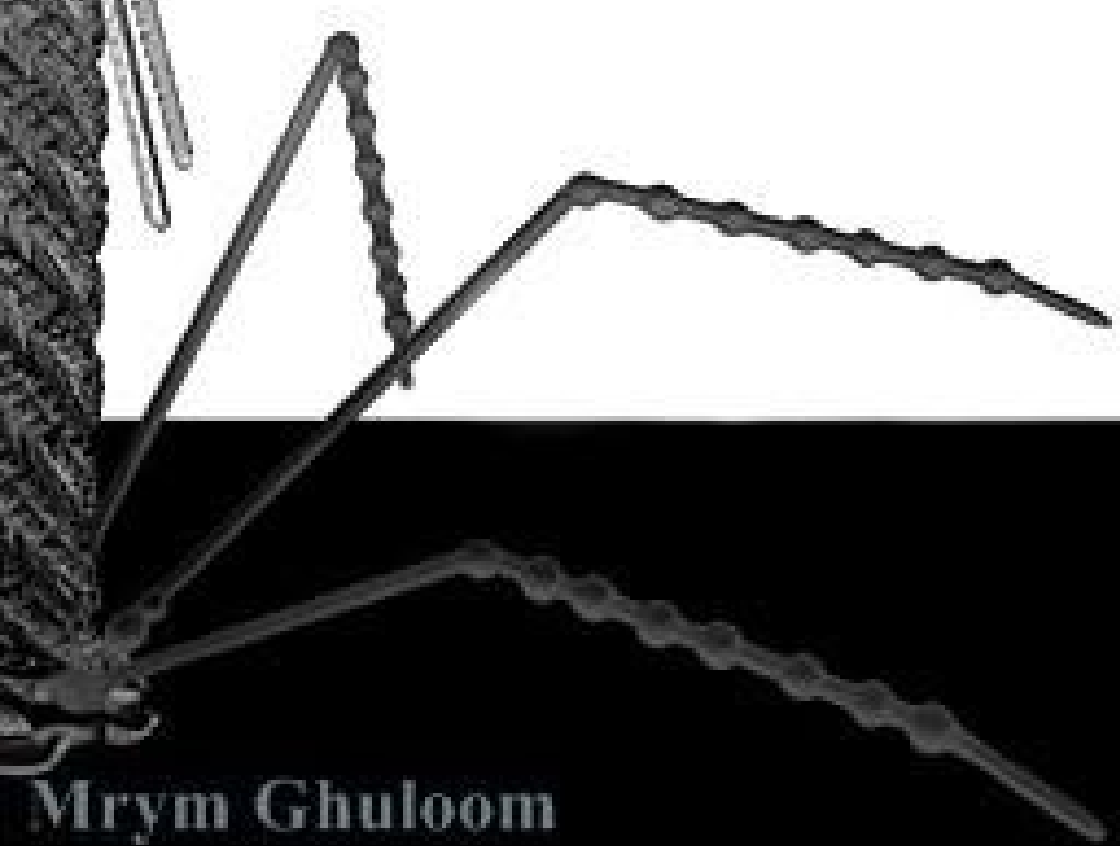


Microbiology

Lecture No:.....5-Virology

Dr Name:.....Hamed Al-Zoubi

Sheet ☐ Slide ■



Mrym Ghuloom

Virology – **Pathogenesis of viral infections**

JU- 2nd Year Medical Students

By

Dr Hamed AlZoubi – Microbiology and Immunology Department – Mutah University.

MBBS (J.U.S.T)

MSc, PhD medical microbiology (UK).

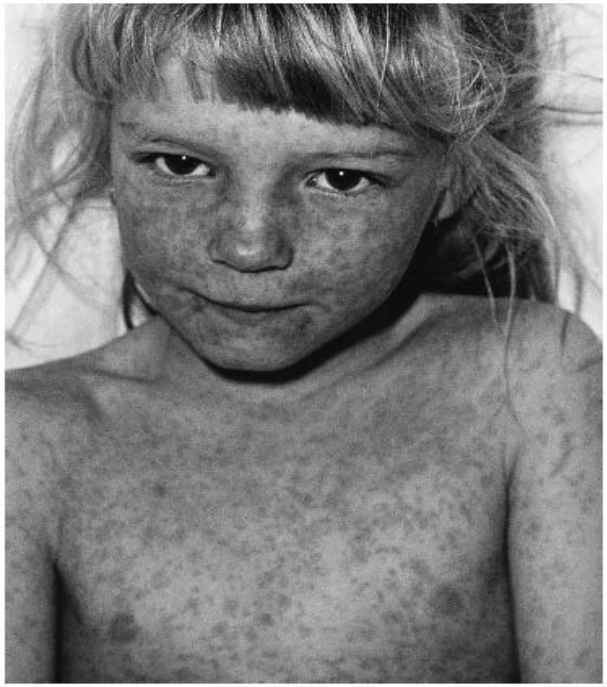
FRCPath (associate, medical microbiology).

dr_alzoubi@yahoo.com

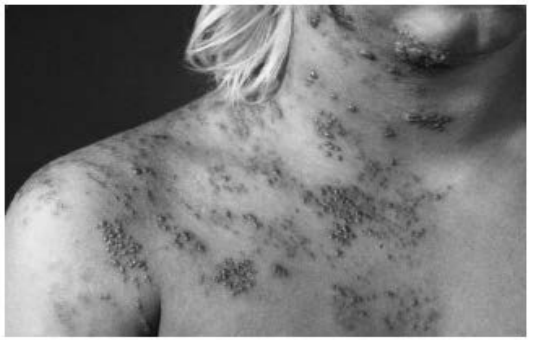
Pathogenesis of viral infections

- Introduction
- Interaction between viruses and host cells
- Spread /shedding

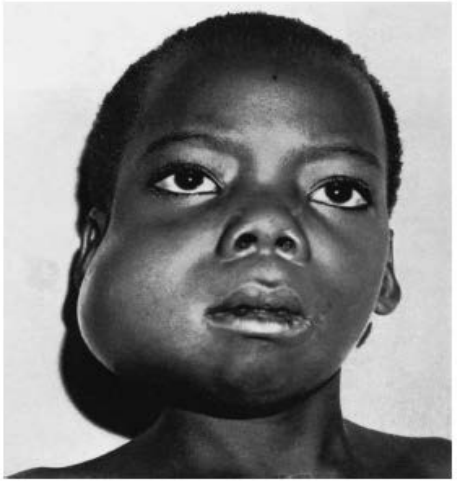
Pathogenesis of viral infections



(a)



(b)



(c)

Fig. 4.1 Differing manifestations of viral infections. **(a)** Child with measles). **(b)** Elderly patient with herpes zoster. **(c)** Seven-year-old boy with Burkitt's lymphoma involving the right mandible (by courtesy of Dr Joan Edwards).

Pathogenicity and Virulence

- Used interchangeably but not fully accurate

- Both compare severity of disease but:
- Pathogenicity: compares disease severity between 2 different viruses (rabies more pathogenic than measles, influenza more than rhinovirus)

- Virulence: compares severity caused by same microorganism but different species

Pathogenicity and Virulence

✓ For example:

- HSV A and B can cause skin lesions but 10 copies of A or 10000 copies of B needed to kill a mouce.
- So strain A is 1000 times more virulent than B
- Why?

Pathogenicity and Virulence

- Nucleotides difference in the DNA or RNA due to mutations
- **Poliovirus 3** virulent and avirulent strain (vaccine version) differ in 10 bases out of 7430 bases.

- One base of the 10 different bases was responsible for a new amino acid and avirulent strain

Pathogenicity and Virulence

- Avian Influenza B:

One base change near receptor binding site on the haemeagglutinin (HA) →

make the strain virulent and can allow the virus to bind to both avian and mammalian cells

→ leading to pandemics

Steps in the pathogenesis:

Invade → replicate locally at site of infection

→ escape immune system → spread from site of infection to other areas usually via blood stream

→ exit the host and start the infectious cycle again to ensure its survival

Incubation period

- Necessary for clinical diagnosis, outbreak tracing, infection control,
- Can be:
- Short: less than a week (RESP, ARBOVIRUSES)
- Medium: 1-3 weeks (MMR, polio, SARS)
- Long: weeks-months (HEPATITIS, RABIES)
- Very long: years (SSPE,PRIONS, PML)

Reproduction number, Ro

- How infectious is a virus
- The average number of secondary cases generated by one primary case
- R_0 smallpox = 2
- R_0 Influenza = 6-8
- R_0 measles = 10
- $R_0 < 1$
- Incubation period should be taken in consideration also

Interaction between viruses and host cells:

This will determine the infection site, type and outcome

1 . Cellular factors

- Presence of receptor
- Proper environment: e.g some respiratory viruses replicate at a temperature of 33^{o}C in the nose (upper respiratory tract infection) and some at alveoli 37 ^{o}C (lower respiratory tract infection)

Interaction between viruses and host cells:

- 2 . Cytopathic effects (CPEs)
- The effect on the cell itself (kill, fuse, uncontrolled growth, inclusion bodies)
- A . Cell lysis:
- Viral early proteins will stop the cellular expression of macromolecules to enable viral proteins expression
- Accumulation of viral capsid proteins (e.g Adenovirus) will lead to stopping of viral and cellular proteins and the cell will be full – burst and die and the virus will be released (bursters)

Interaction between viruses and host cells:

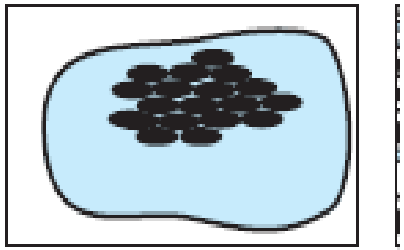
B . cell fusion

- Viral fusion proteins will facilitate entry and may result in cellular fusion and the formation of multinucleated giant cells (**syncytia**)

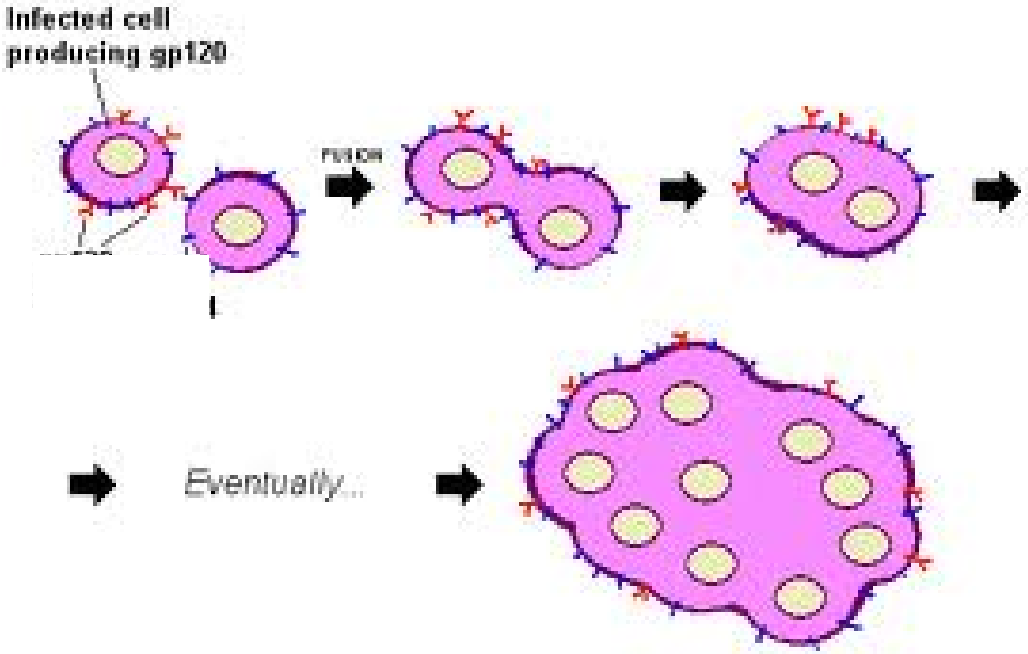
- Paramyxoviruses (measles, respiratory syncytial virus, parainfluenza), herpesviruses and some retroviruses

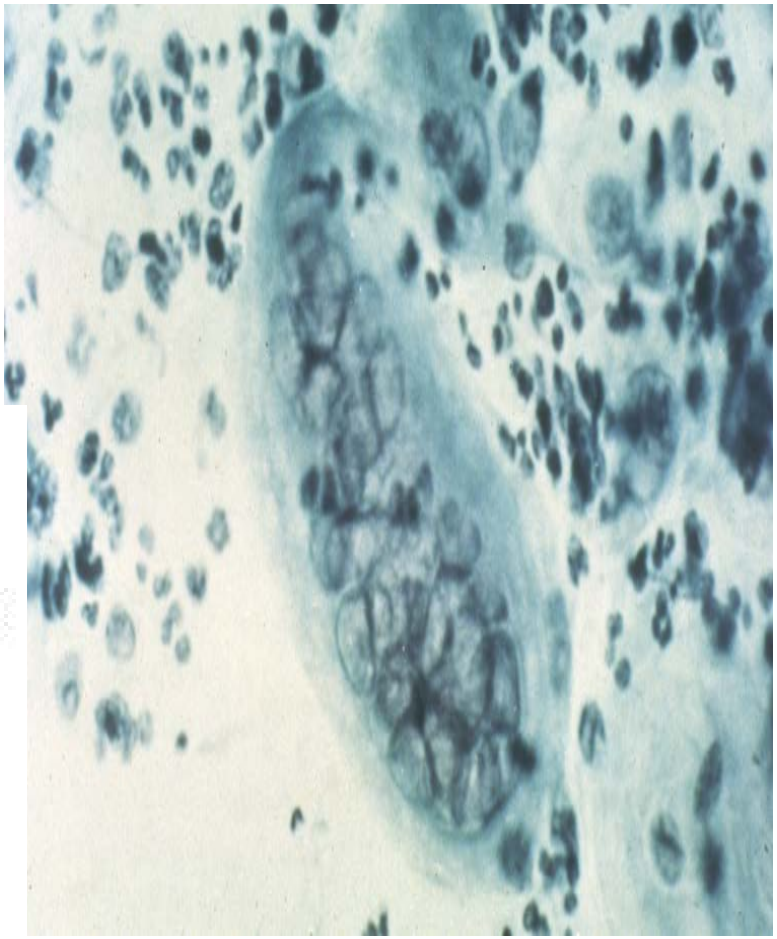
- Such viruses are described as creepers because they can spread from cell to cell without bursting the cell

Interaction between viruses and host cells:



Multinucleated syncytium





Interaction between viruses and host cells:

C . Inclusion bodies IMAGE

- What are they:

Aggregates of the viruses (papovaviruses: papilloma and polyoma viruses)

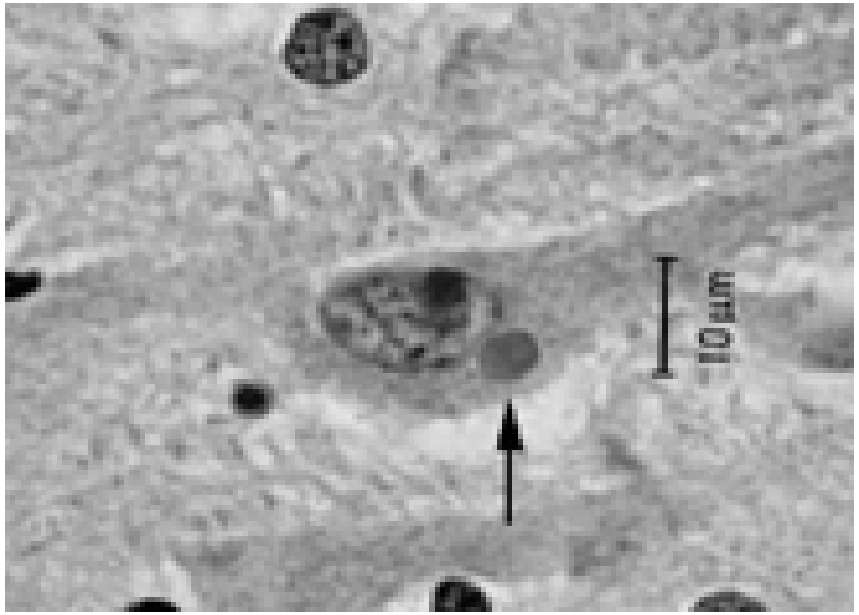
or altered staining of the viral synthesis sites (basophilic, eosinophilic)

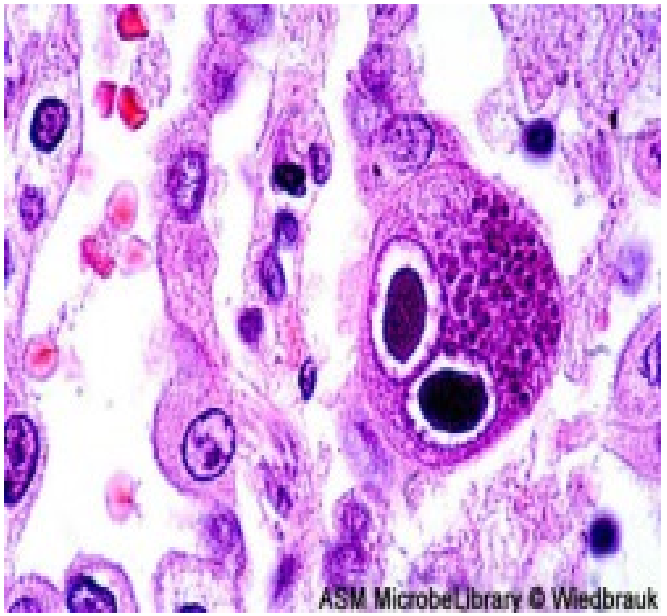
- Site: intranuclear,intracytoplasmic or both
- Detection: by staining or molecular methods

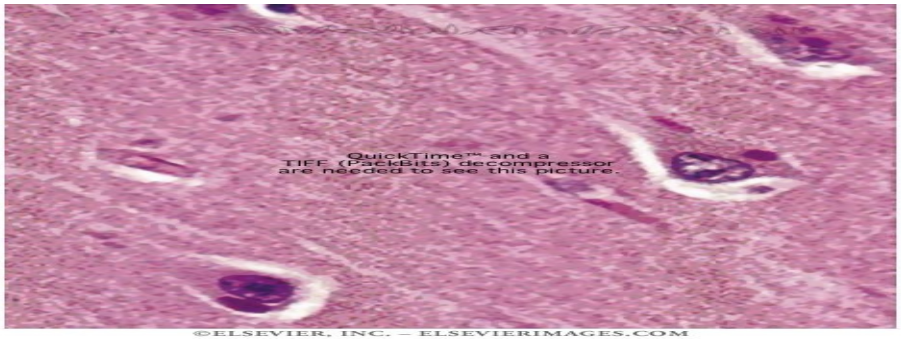
Interaction between viruses and host cells:

- examples:
- Intracytoplasmic eosinophilic: rabies Negri bodies
- Intranuclear basophilic: owl eyes in cytomegalovirus

Interaction between viruses and host cells:







Interaction between viruses and host cells:

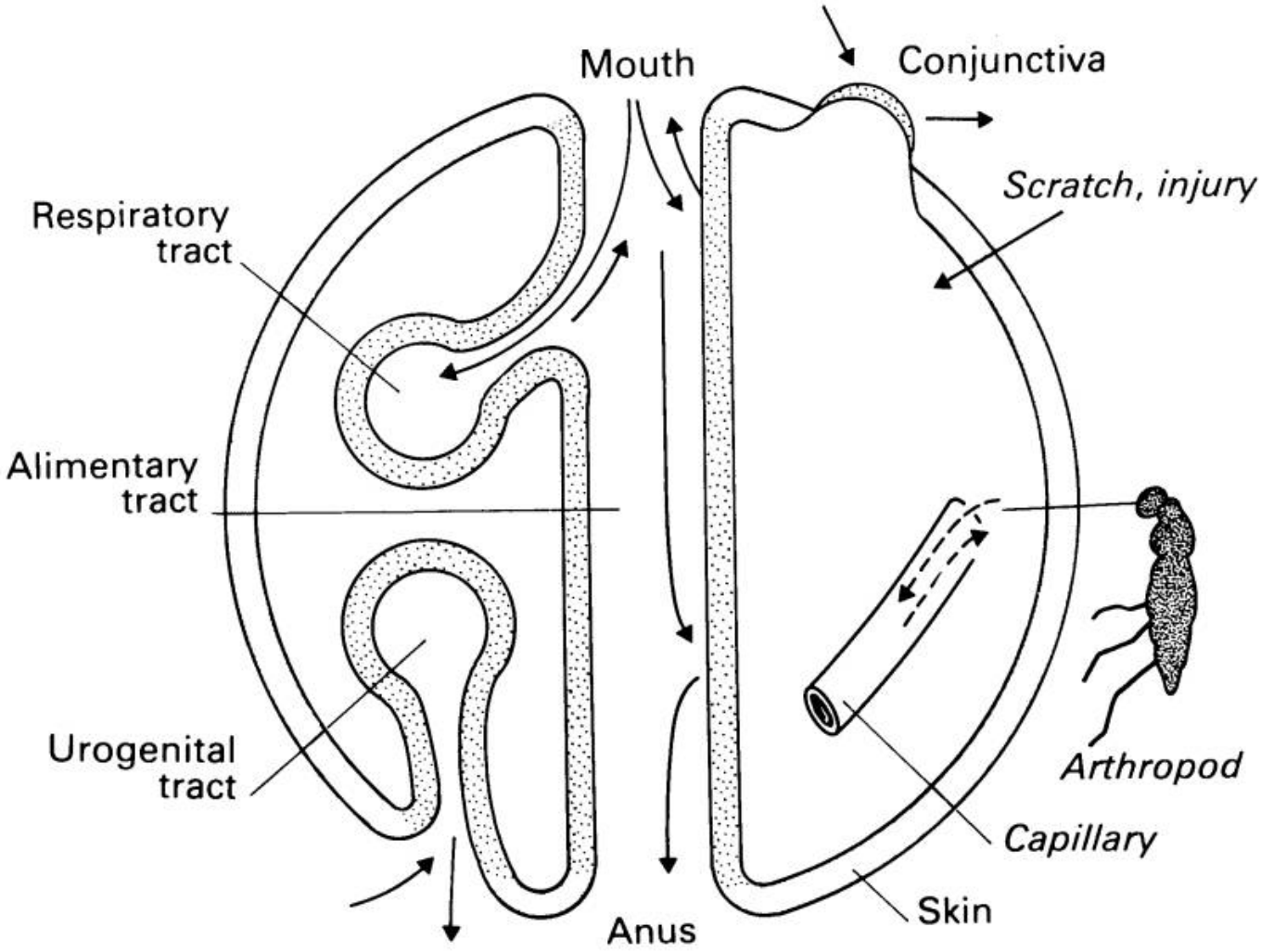
D. New cell surface antigens

- Enveloped viruses will leave antigens on cellular surface
- This stimulates attack by cytotoxic T cells
- Detection by IF staining

E . Malignant changes

Oncoviruses

Spread of viruses within the host: Portal of entry



Spread of viruses within the host

- Skin:
- Skin cells act a barrier so Minor trauma is necessary
- Localized effect and skin lesions e.g: poxvirus, herpesvirus, papillomaviruses
- Generalized effect that might affect body systems: e.g hepatitis B via skin abrasions

Spread of viruses within the host

- Mucus membrane:
- e.g respiratory mucosa might be affected but the effect is on another site e.g the skin

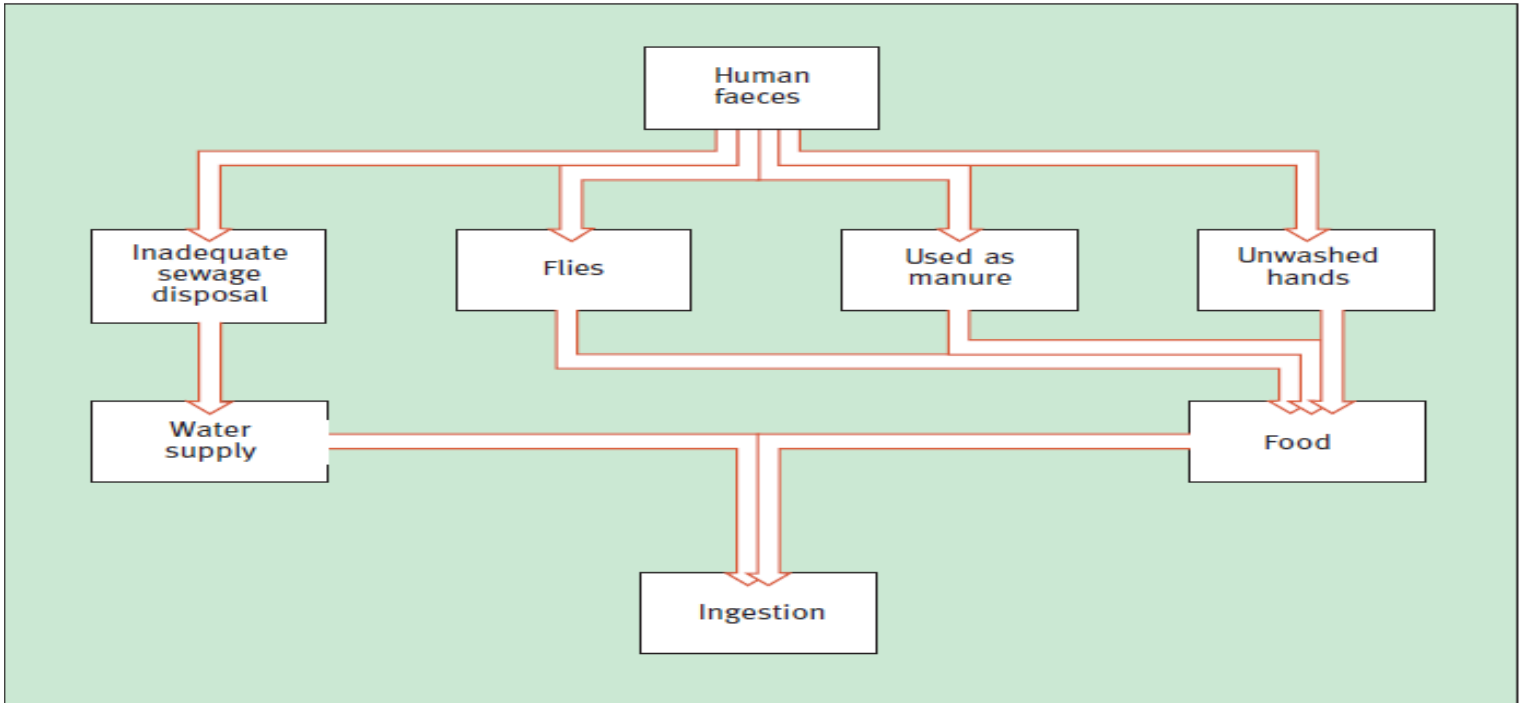
- enterovirus: via GIT but affect CNS and MUSCLES

Spread of viruses within the host

- Respiratory route:
- Small droplets disseminate and penetrate better than large ones
- Crowdedness and humidity also help

Spread of viruses within the host

- Gastrointestinal tract:
- Fecal oral
- Usually resistant to acidity



Spread of viruses within the host

Sexually transmitted diseases:

- AIDS, Hepatitis
- Multiple partners, homosexuality…help

Organ transplants:

- CMV and EBV asymptomatic in donor
- Disastrous in immunocompromised recipient

Spread of viruses within the host

Surgical:

- CJD and rabies : instruments and corneal transplants

Mother to fetus:

- Specialized form of transmission

Shedding

From the primary site or from the target organ

Asymptomatics or carriers may shed and infect

e.g:

HSV: saliva

CMV from urinre milk

The End