Medically Important DNA Viruses

Virology

M.Sc. 2017-2018

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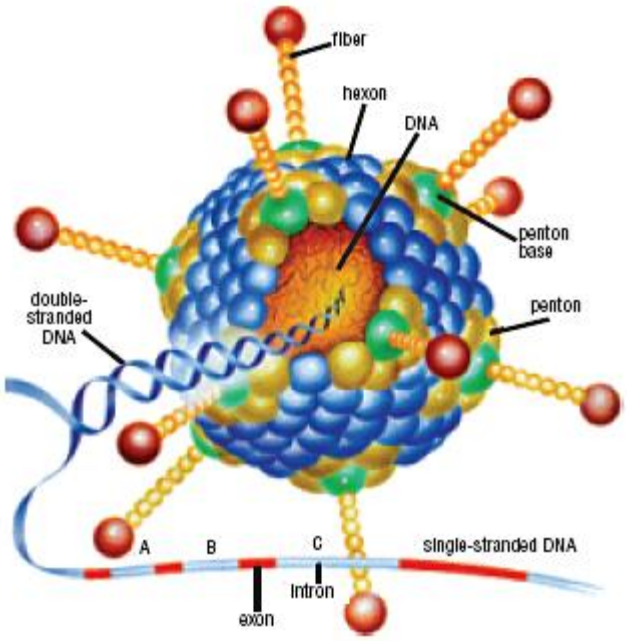
DNA nonenveloped viruses

1. Adenoviruses
2. Parvoviruses
3. Papillomaviruses

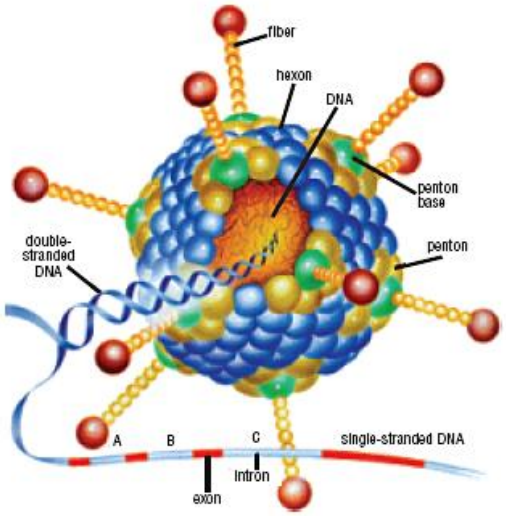
Adenoviruses

Diseases: they cause a variety of upper and lower respiratory tract infections

1)Pharyngitis
2)Conjunctivitis
3)Common cold
4)Pneumonia
5)Keratoconjuntivitis
6)Hemorrhagic cystitis and
7)Gastroenteritis mainly in children under 2 years of age.



Adenoviruses



Properties:

- Non-Enveloped
- Icosahedral nucleocapsid
- The genome is linear double stranded DNA
- They are the only viruses with a fiber protruding from each of the 12 vertices of the capsid. The fiber is the organ of attachment and is a heamagglutinin.
- There are 41 antigenic types; the fiber protein is the main type-specific Ag.
- The viruses are **transmitted** either by aerosols or by fecal-oral routs.

Adenoviruses

Pathogenesis:

Adenoviruses infect the mucosal epithelium of the respiratory tract, GIT and conjunctivas. In addition to acute infection, they cause a latent infection in the adenoids and tonsillar tissue.

Diagnosis: 1) Isolation of the virus in cell culture.

2) Complement fixation.

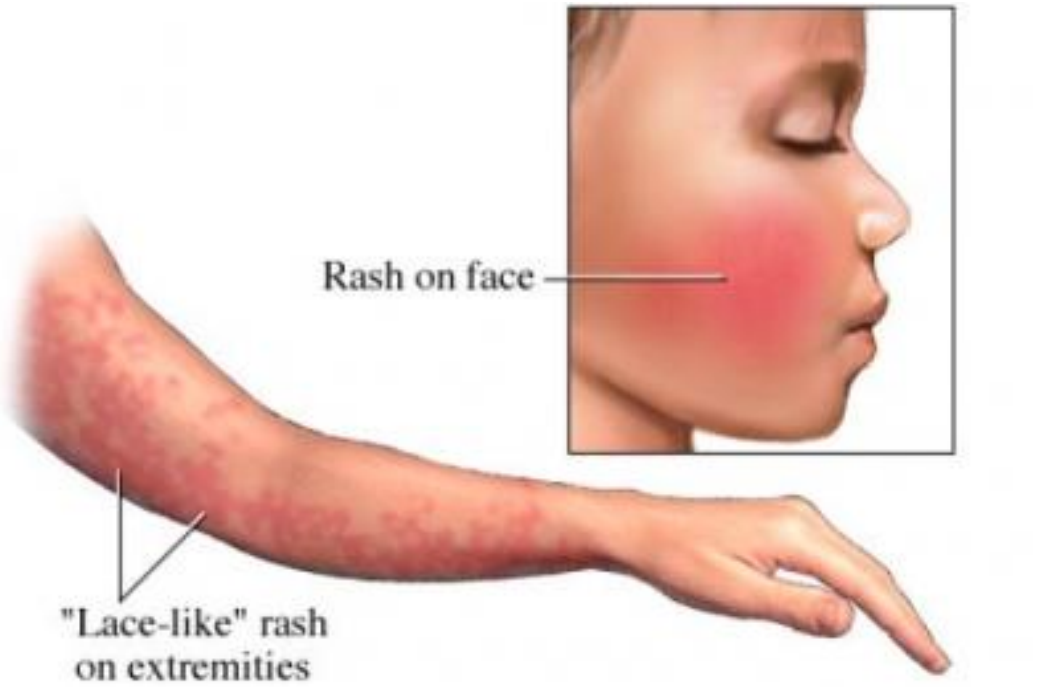
3) Heamagglutination inhibition.

Parvovirus B19

Diseases:

- **Erythema infectiosum (Slapped Check syndrome, Fifth disease)**: red rash, fever and runny nose (The disease in children is called fifth disease. The four other that cause skin rash in children are measles, rubella, scarlet fever, and roseola).
- **Aplastic anemia:** especially in children with sickle cell anemia.
- **Fetal infection:** congenital malformations including hydrops fetalis.

Parvovirus B19



Parvovirus B19

Properties: 1) very small virus (22nm). 2) non-enveloped. 3) Single stranded DNA genome. 4) There is no virion polymerase. 5) Icosahedral symmetry.

Diagnosis: 1- Fifth disease and Aplastic anemia diagnosed by detecting IgM Abs.

2**-** In immunocompromised patients Abs may not be detected, viral DNA in blood is assayed using PCR.

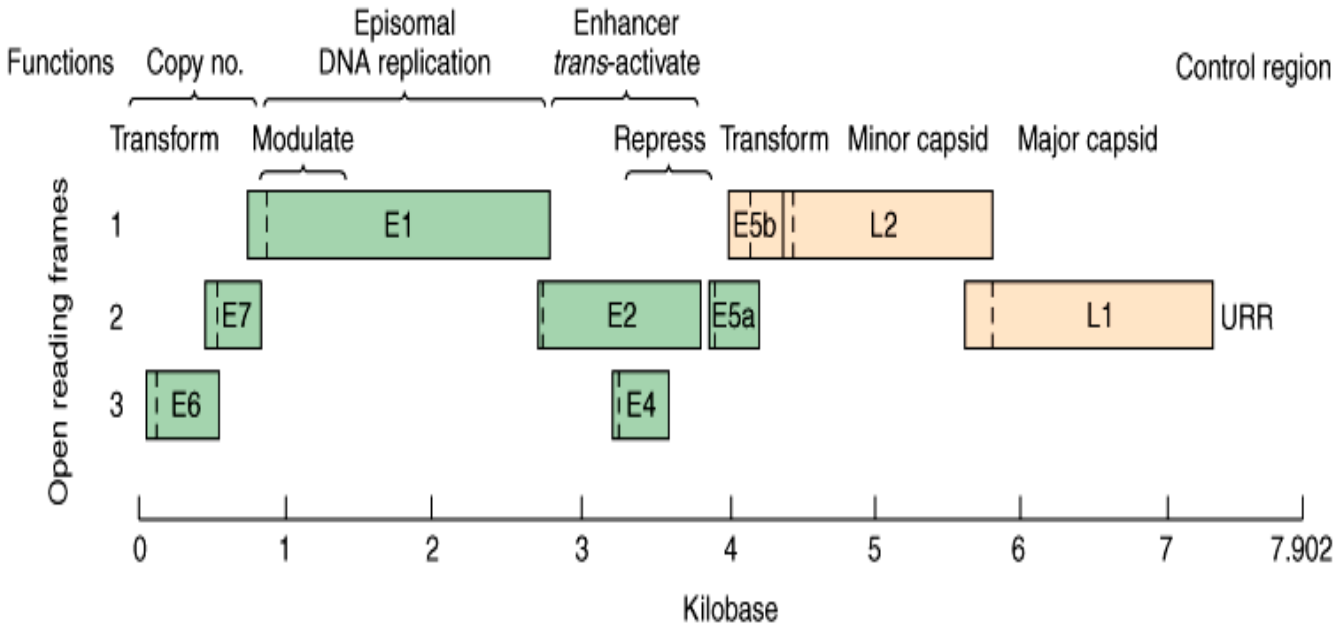
Papillomaviruses

- The Papillomaviridae family is a very large virus family currently divided into 16 genera, of which five contain members that infect humans:
- *Alpha* ,-*Beta* ,-*Gamma* ,-*Mupa* ,-and *Nupapapillomavirus*. The papillomaviruses are former members of the Papovaviridae family. Although papillomaviruses and polyomaviruses share similarities in morphology, nucleic acid composition, and transforming capabilities, differences in genome organization and biology led to their separation into distinct virus families .

Important Properties of Papillomaviruses[a]
Virion: Icosahedral, 55 nm in diameter
Composition: DNA (10%), protein (90%)
Genome: Double-stranded DNA, circular, 8 kbp, MW 5 million
Proteins: Two structural proteins; cellular histones condense DNA in virion
Envelope: None
Replication: Nucleus
Outstanding characteristics:
Stimulate cell DNA synthesis
Restricted host range and tissue tropism
Significant cause of human cancer, especially cervical cancer
Viral oncoproteins interact with cellular tumor suppressor proteins

[a]Formerly classified in Papovaviridae family.

Papillomaviruses



Source: Brooks GF, Carroll KC, Butel JS, Morse SA, Mietzner TA: *Jawetz, Melnick, & Adelberg's Medical Microbiology, 25th Edition*: http://www.accessmedicine.com

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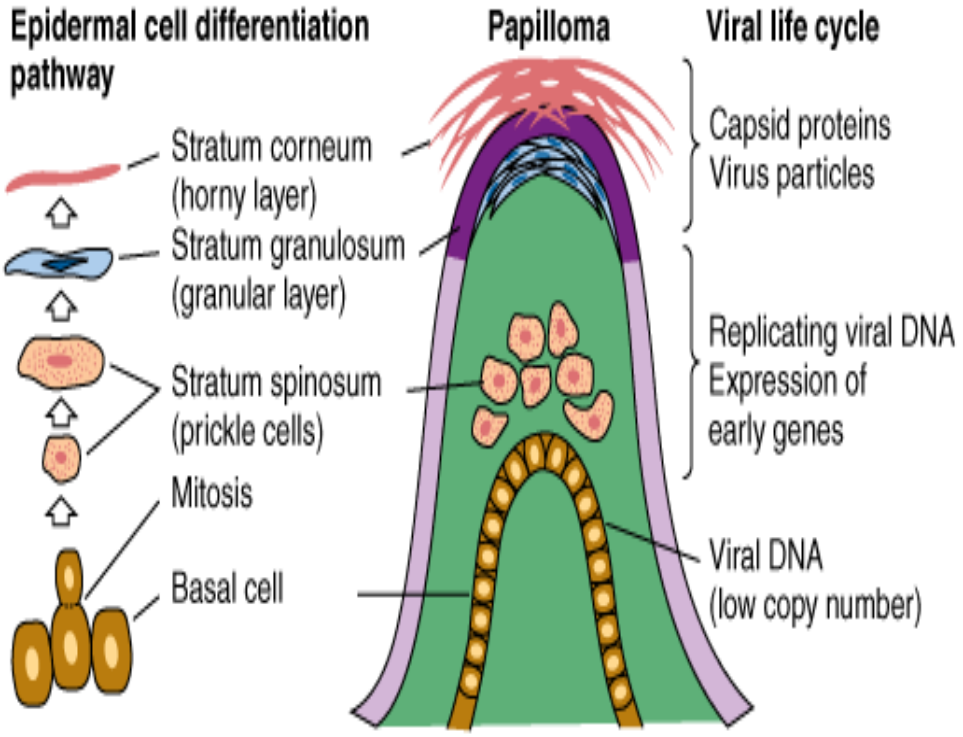
Map of the human papillomavirus genome (HPV-6, 7902 base pairs). The papillomavirus genome is circular but is shown linearized in the upstream regulatory region (URR). The upstream regulatory region contains the origin of replication and enhancer and promoter sequences. Early (E1–E7) and late (L1, L2) open reading frames and their functions are shown. All the open reading frames are on the same strand of viral DNA. Biologic functions are extrapolated from studies with the bovine papillomavirus. The organization of the papillomavirus genome is much more complex than that of a typical polyomavirus (compare with Figure 43–7). (Reproduced with permission from Broker TR: Structure and genetic expression of papillomaviruses. Obstet Gynecol Clin North Am 1987;14:329.)

Papillomaviruses

Pathogenesis & Pathology

- Papillomaviruses cause infections at cutaneous and mucosal sites, sometimes leading to the development of different kinds of warts, including skin warts, plantar warts, flat warts, anogenital warts, laryngeal papillomas, and several cancers, including those of the cervix, vulva, penis and anus, and a subset of head and neck cancers.
- The multiple types of HPV isolates are preferentially associated with certain clinical lesions, though distribution patterns are not absolute. HPV genital infections are sexually transmitted and represent the most common sexually transmitted disease in the United States.

Papillomaviruses



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Schematic representation of a skin wart (papilloma). The papillomavirus life cycle is tied to epithelial cell differentiation. The terminal differentiation pathway of epidermal cells is shown on the left. Events in the virus life cycle are noted on the right. Late events in viral replication (capsid protein synthesis and virion morphogenesis) occur only in terminally differentiated cells. (Reproduced with permission from Butel JS: Papovaviruses. In: *Medical Microbiology*, 3rd ed. Baron S [editor]. Churchill Livingstone, 1991.)

Papillomaviruses

Diseases:

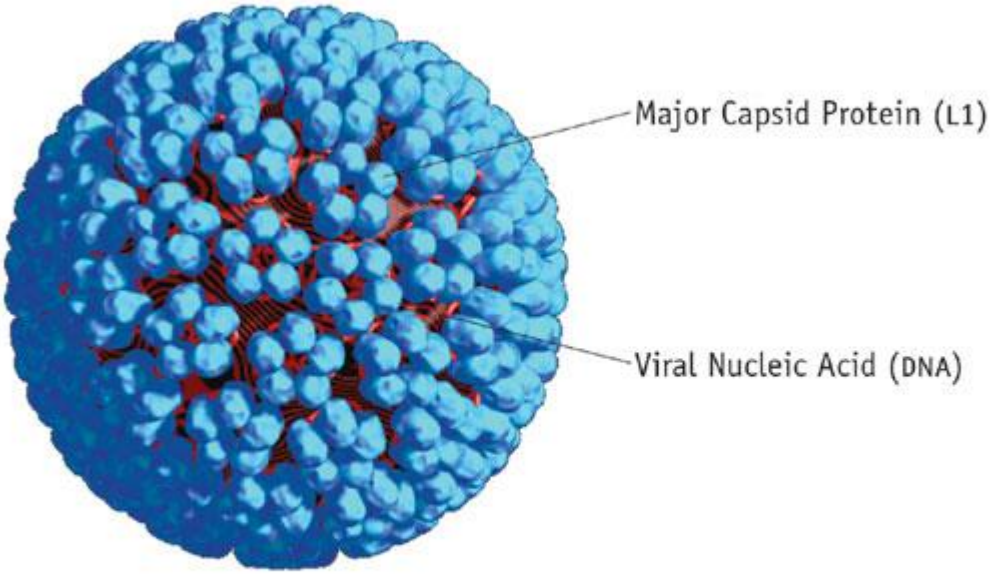
Human papillomaviruses HPV cause papillomas which are benign tumors of the squamous cells

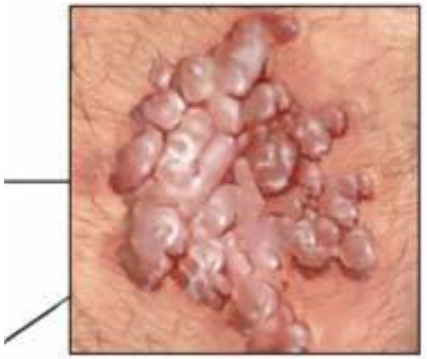
1) Warts of the skin.
2) Genital warts (condylomata acuminata).
3) Carcinoma of the uterine cervix, penis and anus.

(CA is associated with infection by HPV-16 and 18)

Papillomaviruses

THREE-DIMENSIONAL MODEL OF HUMAN PAPILLOMAVIRUS





Genital warts:
Found on shaft of penis (male), vagina, vulva, cervix (female) and around anus

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Published in The PRN Notebook, Volume 6, Number 3, September 2001 and The PRN Notebook Online at www.prn.org.
Three-dimensional model of HPV created by Louis E. Henderson, Ph.D., Frederick Cancer Research Center.

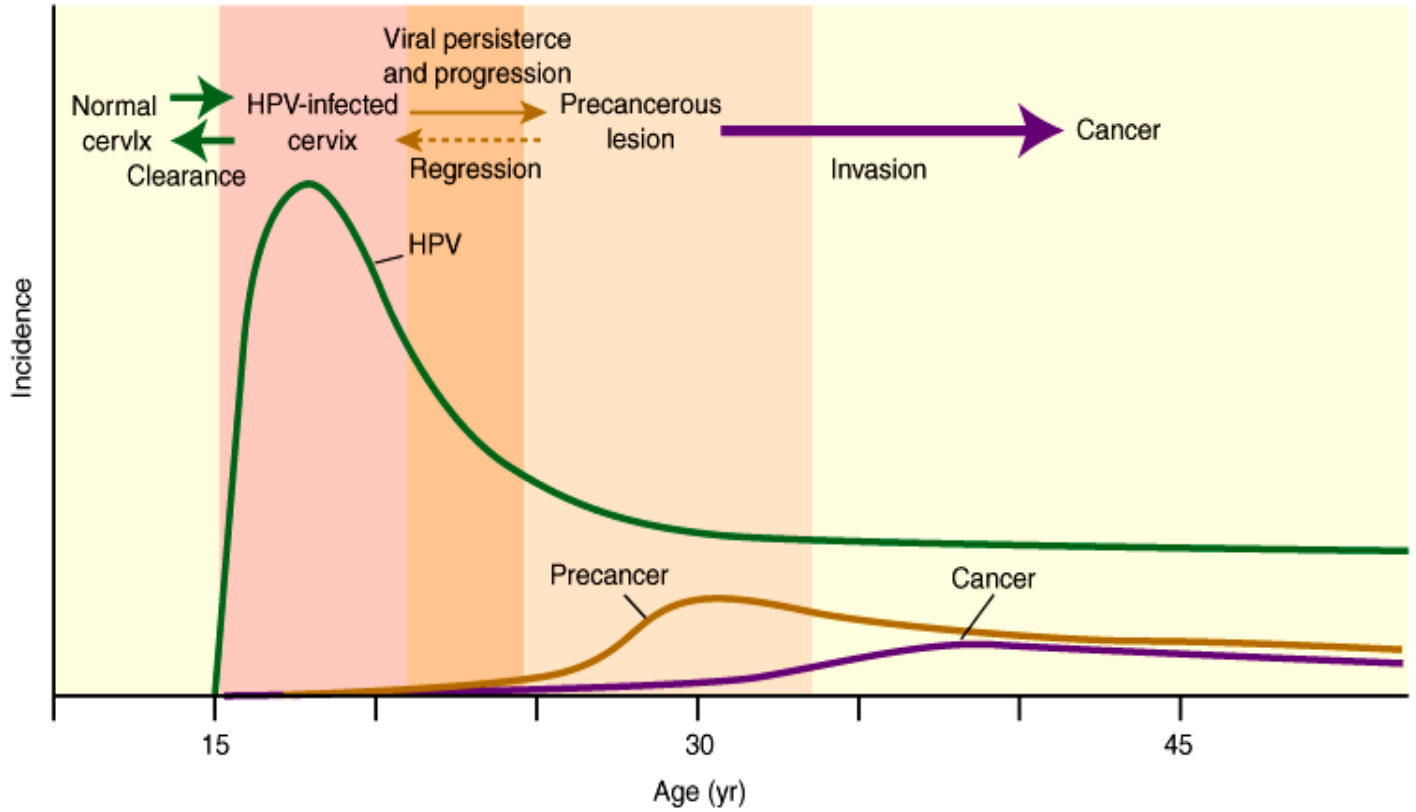
Papillomaviruses

Transmission: skin-skin contact, or genital contact. Genital warts are among the most common sexually transmitted diseases.

Two of the early genes of the virus **E6 and E7** are implicated in the carcinogenesis in a mechanism similar to that mentioned in HHV-8.

Immunity: both CMI and Ab are induced by viral infection and are involved in spontaneous regression of warts. Immunosuppressed patients eg AIDS have more extensive warts and women with AIDS have very high rate of CA cervix.

Papillomaviruses



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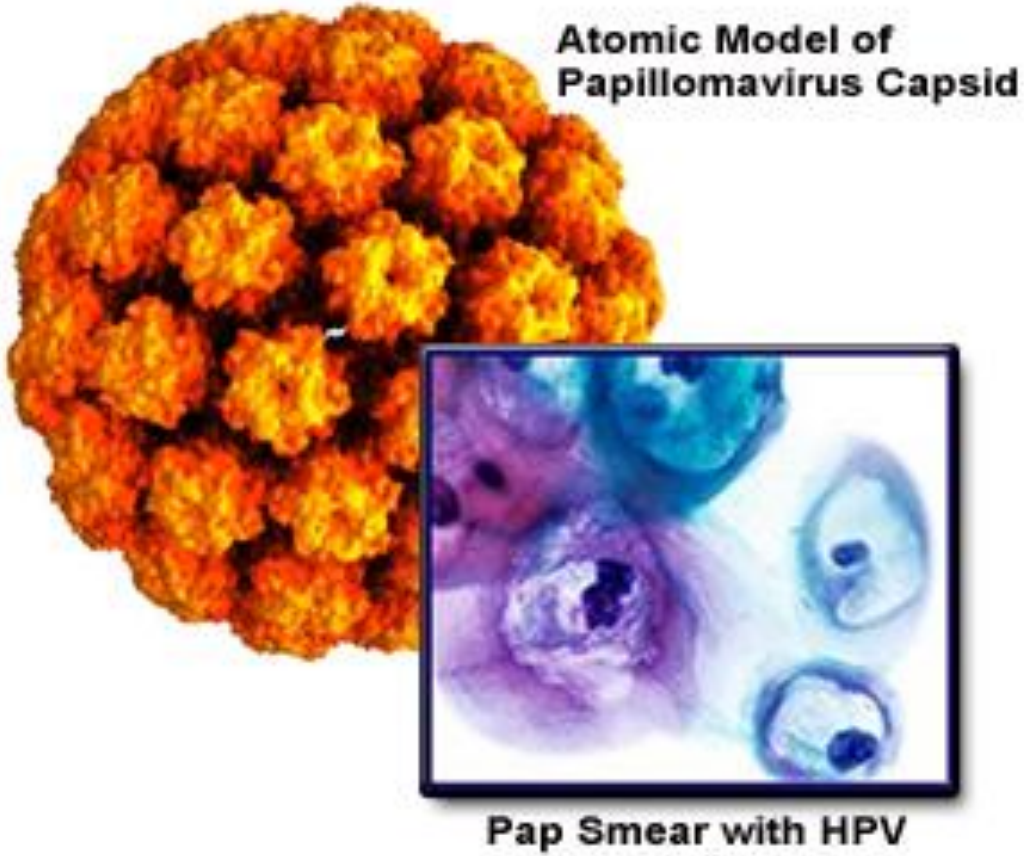
Relationship among cervical HPV infection, precancer, and cancer. The HPV curve shows the high incidence of infection soon after women initiate sexual activity and the subsequent decrease because many infections are self-limited. Precancer incidence curve illustrates the delay between acquisition of HPV infection and precancer development and that only a subset of infected women develop precancers. The cancer incidence curve shows the relatively long interval between precancer and progression to invasive cancer. (Reproduced from Lowy DR, Schiller JT: Prophylactic human papillomavirus vaccines. J Clin Invest 2006;116:1167. Modified with permission from Schiffman M, Castle, PE: The promise of global cervical-cancer prevention. N Engl J Med 2005;353:2101.)

Papillomaviruses

Diagnosis: 1)Clinically. 2)Biopsy shows the presence of **Koilocytes (Cells containing cytoplasmic vacuoles)** 3)DNA hybridization tests to detect the presence of viral DNA.

Treatment: 1) For Genital warts (Podophyllin) and alpha interferon. 2) For skin warts liquid nitrogen and for planter warts surgical removal. 3) For sever HPV infection Cidofovir.

Papillomaviruses




HAVE A NICE DAY