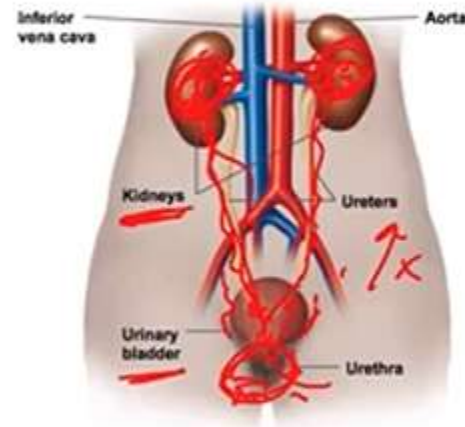


## Structure and Function

- Urinary system
  - Kidneys
  - Ureters
  - Bladder
  - Urethra
- Ureters have valves
  - Prevent backflow of urine to kidneys
  - Protects kidneys from lower UTIs
- Urine has antimicrobial properties
- Flushing action also remove pathogens.



## Normal Microbiota

- Urine is sterile
- Can be contaminated by microbiota of skin at urethra
- Predominant bacteria in vagina
  - Lactobacilli
    - Generates lactic acid
    - Keeps pH low (3.8-4.5)
    - Inhibiting other growth



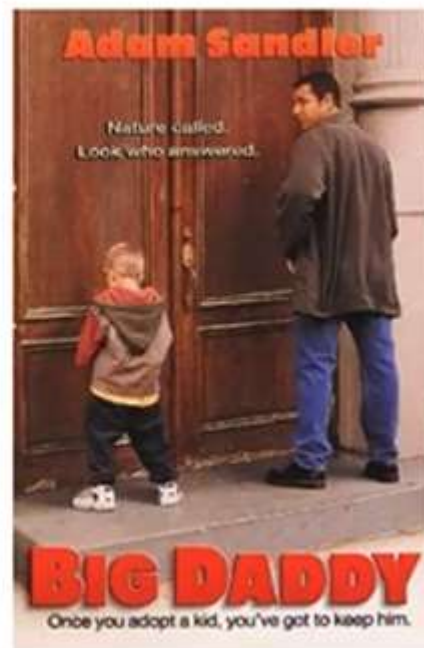
"Urine is sterile. You can drink it."  
--Fight Club

- Generates lactic acid
- Keeps pH low (3.8-4.5)
- Inhibiting other growth
- Yeast (*Candida albicans*)
  - Found in 10-25% of women

"Urine is sterile. You can drink it."  
--Fight Club

## Diseases of the Urinary System

- Urethritis
  - Inflammation of urethra
- Intestinal bacteria predominate UTI
  - Most infections caused by *E. coli*
- Rate of UTI in women is 8x men.



## Diseases of the Reproductive System

- STI (sexually transmitted infection)
- >30 microbes can cause
- 15 million new cases annually in US



annually in US

- Many treated with antibiotics
- Or prevented by condom use.



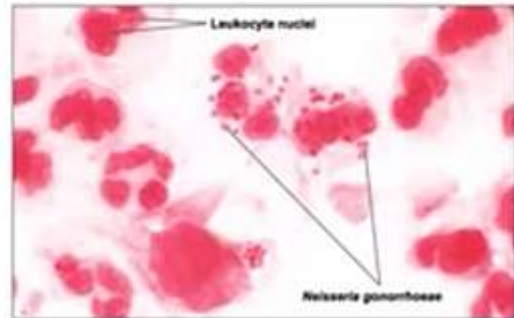
## Pelvic Inflammatory Disease (PID)

- Collective term for bacterial infection of female pelvic organs
  - Uterus, cervix, uterine tubes, ovaries
- Symptoms:
  - Lower ab pain, discharge, fever, chills, painful urination
- Can lead to infertility
- Usually results from coinfection of N. gonorrhoeae and C. trachomatis.



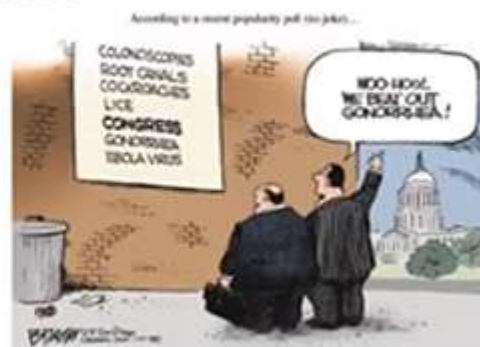
# Gonorrhea

- aka: the clap
- Causative agent: *Neisseria gonorrhoeae*
- Gram negative diplococcus
- most common reportable communicable disease in US
- Cells attach to mucosal cells of epithelial wall via fimbriae
- Invades urethra (men) and cervix (women)
- Triggers inflammation, pus formation
- Coinfection with Chlamydia.



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# Gonorrhea

- Men
  - Painful urination
  - Discharge of pus
- Women
  - Often asymptomatic
  - But can spread to uterus or fallopian tubes
  - Can contribute to pelvic inflammatory disease (PID)
- Eyes of infant can be infected during birth
  - Ophthalmia neonatorum can result in blindness
  - Antibiotics placed in eyes of newborn.



# Gonorrhea

- Treatment
- No vaccine
  - No effective adaptive immunity
  - Exhibits antigenic variability
- Ceftriaxone (a cephalosporin)
- Also treat for Chlamydia (tetracycline).



# Chlamydia

- Signs and symptoms
- Males: mild, painful urination, inflammation of epididymis
- Females: usually asymptomatic, abdominal pain
  - Can lead to PID
  - 5x as many reported cases than men.



# Chlamydia

- Treatment:
  - Susceptible to tetracyclines
- No vaccine.

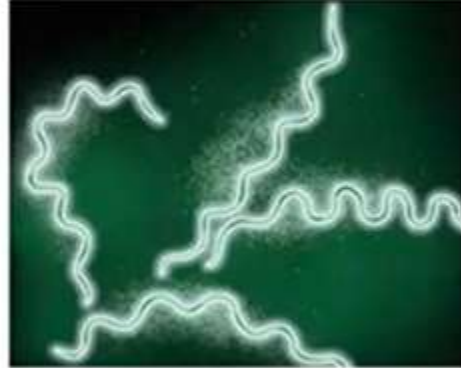




# Syphilis

- Causative agent:
- *Treponema pallidum*
- Gram negative spirochete
- Lacks enzymes to build many macromolecules
- Relies on host
- Slow generation times: 30 hours

Syphilis Bacteria



# Syphilis

- Sexually transmitted
- from spirochete-containing lesions of skin or mucous membranes
  - (genitals, mouth, rectum)
- Progresses through several stages.



# Syphilis

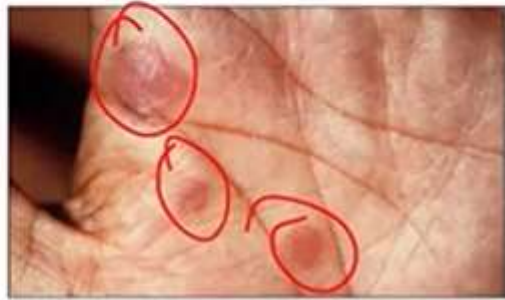
- Primary Stage
  - Initial sign is small, hard-based chancre
  - Appears at site of infection (2-10 weeks)
  - Painless
  - Fluid is highly infectious
  - Heals in a few weeks.



(a) Chancre of primary stage on a male in genital area.

# Syphilis

- Secondary Stage
  - Characterized by skin rashes
    - Notably on palms and soles
  - Lesions of the rash contain spirochetes
  - Highly infectious
  - Can last 2-6 weeks
  - Spontaneously heals
  - Symptoms subside, can enter latent period
    - No symptoms, not infectious
  - Most cases do not progress beyond latent stage.



(b) Lesions of secondary syphilis rash on a palm; any surface area of the body may be afflicted with such lesions.



(b)

# Syphilis

- Primary and secondary stages not disabling
- Tertiary Stage
  - 25% of untreated cases progress here
  - May occur 10-20 years after infection.



(e) Gummas of tertiary stage on the back of an arm; gummas such as these are rarely seen today in the era of antibiotics.



*Alphonse Capone*



# Syphilis

- Tertiary
  - Characterized by gummas
    - Progressive inflammation
    - Appear as rubbery masses of tissue
      - Especially skin and bones
      - Not infectious
  - Neurosyphilis
    - Parts of CNS affected
    - Dementia, seizures
- Antibiotics makes Tertiary Stage rare
  - Penicillin, tetracycline.



(e) Gummas, tertiary stage on the back of an arm; gummas such as these are rarely seen today in the era of antibiotics.



→ *Alphonse Capone*

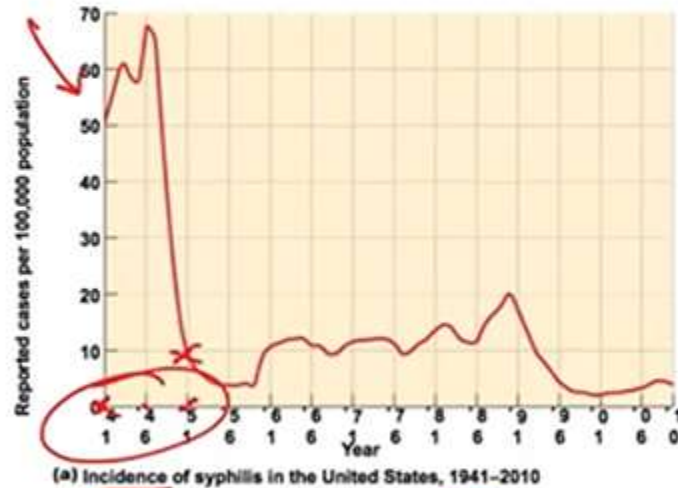
# Syphilis



- Congenital Syphilis
  - Transmitted across placenta to fetus
  - Damage to mental development
  - Most common when pregnancy occurs during latent period
  - During primary or secondary
    - Likely to produce stillbirth
  - Treatment with antibiotics during first two trimesters can prevent.

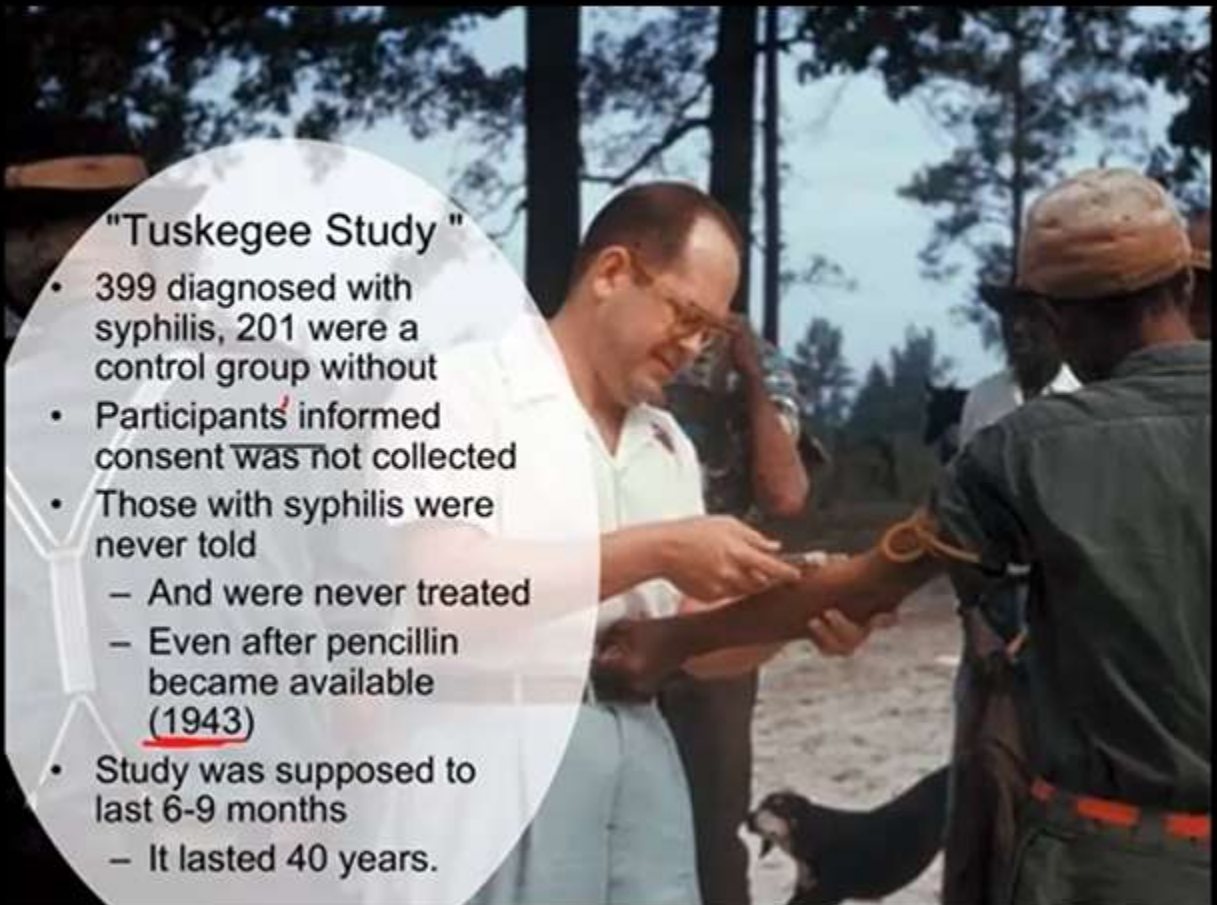
# Syphilis

- Treatment
  - Penicillin
  - Effective at all stages
- Prevention
  - Condoms
  - Early diagnosis
  - No vaccine.



## — "Tuskegee Study of Untreated Syphilis in the Negro Male"

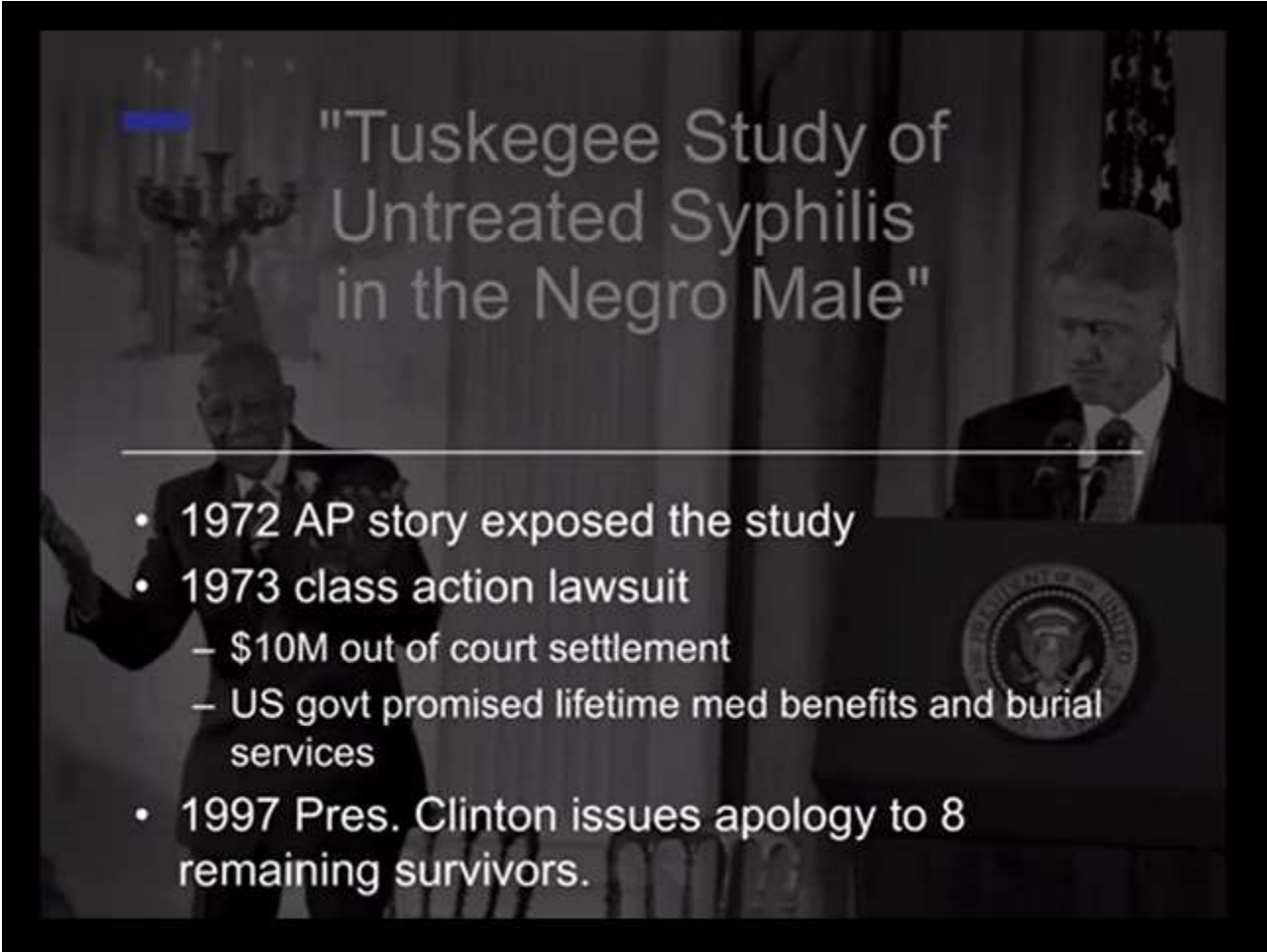
- 1932
- The US Public Health Service conducted a secret experiment
  - To study the progression of syphilis- without treatment
- Fliers in Macon County, Ala promising "colored people" treatment for "bad blood"
  - Free meals, physicals, burial insurance
- 600 men signed up
  - All were black, most were poor.



### "Tuskegee Study "

- 399 diagnosed with syphilis, 201 were a control group without
- Participants informed consent was not collected
- Those with syphilis were never told
  - And were never treated
  - Even after penicillin became available (1943)
- Study was supposed to last 6-9 months
  - It lasted 40 years.





## "Tuskegee Study of Untreated Syphilis in the Negro Male"

- 1972 AP story exposed the study
- 1973 class action lawsuit
  - \$10M out of court settlement
  - US govt promised lifetime med benefits and burial services
- 1997 Pres. Clinton issues apology to 8 remaining survivors.

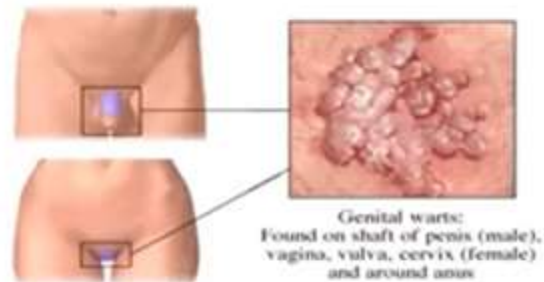


## Genital Warts and HPV

- Causative agent:
- Human Papillomavirus
- Non enveloped DNA virus
- >200 different types; 30 infect genital tract
- Transmitted skin-to-skin or sexual contact
- Infects squamous epithelial cells.

# Genital Warts and HPV

- Visible genital warts
  - HPV-6, and HPV-11
- Most common worldwide STI
- Most are benign
- Some cause cancer
- HPV-16, HPV-18 cause 70% of cervical cancer
  - But also oral, anal, and penile cancer.



# HPV and Cancer

G<sub>1</sub> S G<sub>2</sub> M


- Virus produces proteins E6 and E7
- Bind and interfere with p53

p53 = tumor suppressor

- It detects mistakes made in cell cycle
- Arrests growth.



# HPV and Cancer

- Treatment
  - No cure
  - Most HPV infections resolve spontaneously
  - Topical medications for warts or ablation
- Pap smears: important screening tool for cervical cancer 
  - Within 3 years of first partner or by age 21.

Pap smear:  
cells are scraped from the cervix  
and examined under a microscope  
to check for  
disease or other  
problems



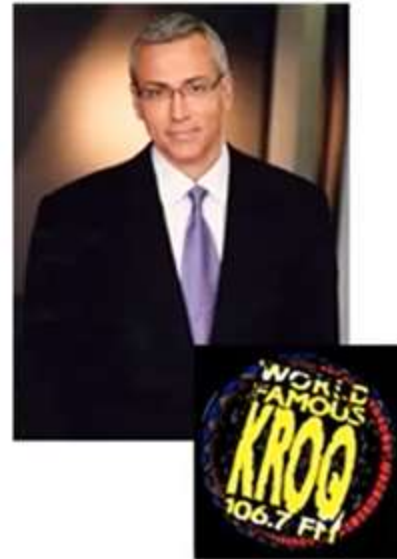
Cervix viewed  
through speculum  
with patient in  
lithotomy position



# HPV and Cancer

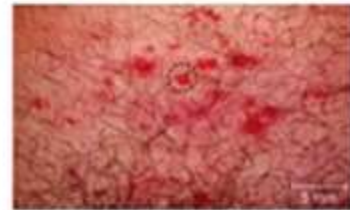
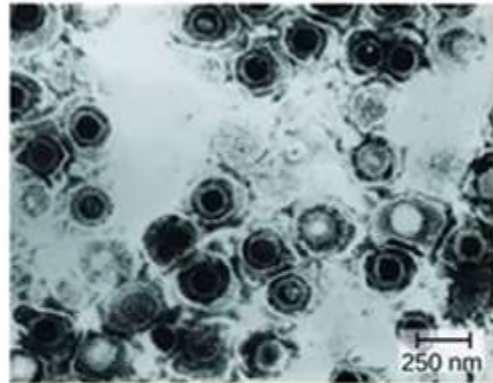
- Vaccine
- Cervarix
  - Protects against cervical cancer (HPV 16, 18)
- Gardasil 9
  - Protects against genital warts (HPV 6, 11)
  - And cancers of anus, vagina, vulva, cervix
- Recommended for boys and girls at age 11 or 12.

Dr Drew



# Herpes

- Genital herpes
- Caused by herpes simplex virus type 2 (HSV-2) (enveloped DNA virus)
- 25% of people over 30 infected in US
- Transmission occurs most often when lesions present
- Virus replicates in skin/mucous membrane at site of infection
  - Vesicle



# Herpes

- Lifelong latency in nerve cells
- Possible recurrences
- Decrease over time
- Treatment
  - No cure
  - Antiviral drugs (Valtrex) suppress outbreaks.

