HIV & AIDS in Relation to Other Pandemics

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Family Heirlooms
- Retroviruses
- Herpesviruses
- Papilloma viruses
- Hepatitis viruses?

Temporary Exhibits
- Rabies
- West Nile
- Nipah
- Lassa
- Ebola
- SARS?

New Acquisitions
- Measles
- Smallpox
- Influenza
- HIV
Recent Origin of Epidemic Diseases

Hunter-gatherers: \( R_0 < 1 \)

Dense populations: \( R_0 > 1 \)
Natural Bioweapons of Mass Destruction
A Richter Scale of Viruses and Global Mortality

- HIV
- HBV + HCV
- Measles
- RSV, Rota
- Flu
- Dengue
- HPV
- West Nile
- SARS
- Ebola
- Polio
- Hanta

Vaccines - weapons of mass protection - led to the eradication or reduction of:
- Smallpox
- Yellow Fever
- Polio
- MMR

Log$_{10}$

1. Tobacco
2. Malaria
3. Non-HIV TB
4. Accidents
5. Suicide
6. vCJD

Weiss & McLean, 2004
Origins of HIV
Ex Africa semper aliquod novi

HIV-1: From *Pan* to pandemic
Multiple transfers (M, N, O)
Date of M transfer ~1931

HIV-2: From sooty mangabey
Date of transfer ~1940

Natural or artificial?

Ebola also arose in Africa, but SARS and 'flu in China,
Nipah in Malaysia, vCJD in UK & Hanta in USA.
HIV-1 derives from SIV of *Pan troglodytes troglodytes* not from *P. t. schweinfurthii* subspecies
How Syringes Sped the Spread of HBV, HCV & HIV

Preventing HIV Transmission

Sexual health:
- Fewer partners
- Condoms
- Treat STIs (eg gonorrhea, herpes)
- Vaginal microbicides

Blood:
- Screen all donations
- Clean needles

Mother to child:
- Anti-HIV drugs
- Breast feeding?

Vaccine:
- No safe efficacious vaccine in sight
## Cross-Species Transmission of Primate Retroviruses

<table>
<thead>
<tr>
<th>Subfamily</th>
<th>Virus</th>
<th>Former Host</th>
<th>New Host</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta</td>
<td>SRV-2:</td>
<td>Macaque</td>
<td>Human</td>
</tr>
<tr>
<td>Gamma</td>
<td>GALV:</td>
<td>Gibbon</td>
<td>Monkey</td>
</tr>
<tr>
<td></td>
<td>BaEV:</td>
<td>Baboon</td>
<td>Cats</td>
</tr>
<tr>
<td>Delta</td>
<td>STLV:</td>
<td>Chimp</td>
<td>Human</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Baboon</td>
<td>Human</td>
</tr>
<tr>
<td>Spuma</td>
<td>SFV:</td>
<td>Chimp</td>
<td>Human</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Baboon</td>
<td>Human</td>
</tr>
<tr>
<td>Lenti</td>
<td>SIV:</td>
<td>Chimp</td>
<td>Human</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(SIVcpz)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mangabey</td>
<td>Human</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(SIVsm)</td>
<td>Macaque</td>
</tr>
</tbody>
</table>
Papio spp

Felis spp
Pooh: "I only have you along in case I need a transplant"
Pooh: "I only have you along in case I need a transplant"

Piglet: "But you don't know what I have along with me"
Risk of Zoonosis in Xenotransplantation

‘Animals have transmitted viruses to humans throughout history. The added risk of xenotransplantation might be minimal.’

Paul L Herrling, 1998, Head of R&D, Novartis

Yet zoonosis will be more likely if:

• The physical barrier is absent
• The transplant recipient is immunosuppressed
• Genetically modified animals more readily transmit viruses to humans

Benefit vs Risk:

• To the individual
• To the community at large
Global Influenza 1996

HIV Single Individual
6 Years Post Infection

10%

HIV Amsterdam Cohort 1991

Congo 1997

Rapid diversification affects
Drug resistance
Vaccine design
Virulence?

Emerging infections classified according to incubation period and infectiousness

**Incubation period**
from infection to disease

<table>
<thead>
<tr>
<th>Infectiousness</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>R₀</td>
<td>Influenza A</td>
<td>SARS</td>
</tr>
<tr>
<td></td>
<td>BSE</td>
<td>HIV/AIDS</td>
</tr>
</tbody>
</table>

**Infectiousness**

- High
- Low

**Incubation period**

- Short (days or weeks)
- Long (years)

Weiss & McLean, 2004
Impact of HIV/AIDS on other infections

- Higher pathogen load, eg Tuberculosis, Malaria, CMV
- Acute infections become persistent, eg Measles
- Vaccines ceased to elicit protective responses, eg Pneumococcus
- Live attenuated vaccines become virulent, eg Vaccinia
- Transmission of pathogens is exacerbated, eg Tuberculosis
- Opportunistic infections and zoonoses may become endemic in humans, eg Mycobacteria

Novel 20th/21st Century Risk Factors

Global village of 6 billion
  West Nile virus
  SARS

Food technology
  H5N1 influenza
  BSE/vCJD

Iatrogenic
  Injections
  Xenotransplantation

Biological Weapons
  Smallpox, Anthrax

Immunosuppressed populations
  Opportunistic infections

Future epidemics
  Which? Where? When?
"The most likely forecast about the future of infectious disease is that it will be very dull. There may be some wholly unexpected emergence of a new and dangerous infectious disease, but nothing of the sort has marked the past fifty years."

Burnet F.M. & White D. *Natural History of Infectious Disease*, 1972

"There will come yet other new and unusual ailments in the course of time. And this disease will pass away, but later it will be born again and be seen by our descendants"

Girolamo Fracastoro, *De Contagione*, 1546