The Origins & Evolution of SIV and HIV


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*xtemewarezone.blogspot.com/ 2007/09/primates-wallpapers.html*
Background:

Simian Origins

+ Natural hosts of original transmission event

+ Infection in 20 primate species

+ 18 distinct African SIV strains

  * BUT are not known to cause disease in host pop’ns

  * Cross-species transmission and infection:
    ie. SIV of African Green Monkey -> patas monkey
Background:

Simian Origins

+ 5 Lineages:

* SIV Chimpanzee - cpz
** SIV Sooty mangabey / Macaque - sm/mac
* SIV African green monkey (four species) - agm
* SIV Sykes’ monkey - syk
* SIV l’Hoest / Sun-tailed / Mandrill - lhoest, sun, mnd

SIVsm = 1st known lentivirus zoonosis

SIVcpz => HIV-1
SIVsm => HIV-2
SIV Evolution

+ Host-specific clustering: 
  SIV strains within a species form closer relationship 
  than with SIV strains from other species

+ Host-dependent evolution: 
  Divergence of Host lineages → divergence of virus lineages 
  *ie. Chimpanzees (and African Green Monkeys too)*

Implications: 
Long-term evolution of SIV within hosts

Infected common ancestor

vs.

Ancestor infects AGM after speciation, 
diffuses to other AGMs
SIV Evolution

+ Cross-species Transmission:
  Often results in pathology in new host
  Little else is known about pathology and transmission

+ Superinfection: Mosaic genomes
  Different lineages → Mutation and complexity!
  *ie. SIVagm in W. Africa and SIVrcm (red-capped)*

+ SIV-lhoest, -sun and -mnd
  L’Hoest and Sun-tailed = closely related
  Mandrills = distant relative
  *How can they have such similar SIV?
  Mandrills are host to two SIVs:
  SIV-lhoest / -sun / -mnd
  another completely divergent, unique strain
HIV Evolution

Evidence of Zoonotic Origins

+ Possible Patterns of Transmission
  - black branches = within nat. host
  - black arrows = cross-species transm.
  - red branches = evolution in humans

+ Similarities in viral genomes
+ Phylogenetic patterns
+ Prevalence in natural hosts
+ Geographic patterns
+ Routes of transmission
HIV Evolution

HIV-2 & SIV-sm

+ Similarities: SIVsm and HIV-2: unique Vpx accessory prot.
+ Phylogeny: gag: common phylo. and geographic link*
+ Prevalence: 22% prev. in W. Africa sooty mangs.
+ Geography: Habitat of s.m. overlaps HIV endemic area
+ Transmission: Hunting of s.m.; orphans = pets

- Hunting + local activities -> transmission
- Less easily transmitted sexually than HIV-1
HIV Evolution

HIV-1 & SIV-cpz

+ Similarities: unique vpu gene
  ~most HIV-1 relatives from P.t.troglodytes

But many concerns/discrepancies:
+ Phylogeny: SIVcpz-ANT diff. from HIV-1
+ Prevalence: low in wild chimps
+ Geography: uncertain overlap habitat and early HIV-1
+ Transmission: ???

Also, main epidemic = HIV-1M
N,O = restricted to W-C Africa
HIV Pandemic

*Where: West-Central Africa: Congo/Cameroon

Why? M,N,O cocirculate
P.t.trog. infected with related strains
Unique subcluster: Cameroon SIVcpz & HIV-1N
Greatest diversity of M
(Origins of M and O unknown)
HIV Pandemic

*When: (W. Central Africa)
1959: HIV-1M
1963: HIV-1O

HIV-1: Three separate transmission events
(Figure A)

HIV-2: At least four separate events
(Figure B; need more info to determine)
**However:**
HIV-1M group: arose from single event
~ diversifies into A-F
~1959 Kinshasa = HIV-1M

Therefore:
1959 = est. timing of pandemic from most common ancestor
Other attempts -> 1930 +/- 20yrs
HIV Pandemic

*How/Why:

Considerations:

>7 transmission events of SIV\text{sm} and SIV\text{cpz}

Relation: HIV-1M,N,O closer to SIV-cpz from P.t.trog. than to SIV from P.t.schw

Timing of first transmission events in 20th c.
HIV Pandemic

*How/Why:

Hypotheses:

1. Cutaneous/mucosal exposure to infected blood
   unique combination of:
   social disruption
   urbanization
   prostitution
   needle use
HIV Pandemic

*How/Why:

Hypotheses:

2. Attenuated oral poliovirus vaccination trials;
   Belgian Congo, 1950s: transmission event for HIV-1M
   Similar trials in W.C. Africa → HIV-1N,O, HIV-2
   Claimed source: sooty mangabey kidneys?
   No: P.t.trog; timing is too late
HIV Pandemic

Public Health Concerns:

- Already a pandemic from two primate species
- 24 more possible reservoirs
- Bushmeat increase
- Threat of further adaptation of HIV-1 and -2
  - lack of accurate testing
- HIV-1 recombinants increase with increased infections.
  - drug resistance, changed tropism, virulence
HIV Pandemic
Public Health Concerns:

Testing: SIVcpz antibodies/viral RNA in fecal/urine samples
=> Identification of reservoirs, risks
=> Identification of virus origins and potential

Background: www.surfacenormal.com/2007_04_01_archive.html