# Viruses skip species by changing rapidly

October 22 2012, by Faye Flam

While it may be that some Americans doubt we're related to chimps and other primates, viruses recognize the similarities in our cells.

The more closely two species are related, the more easily infections jump between them, said biologist Edward Holmes, who just moved from Penn State to the University of Sydney.

For us humans, that means we're particularly vulnerable to catching diseases from other primates. HIV, for example, in various strains has jumped from primates to humans in at least 12 separate incidents.

Journalist David Quammen explains how scientists traced the complex origin of AIDS in his new book "Spillover: Animal Infections and the Next Human Pandemic."

The implication, wrote Quammen, is that the AIDS epidemic was not the result of some freakish, unlikely event. "No, the arrival of HIV in human bloodstreams was, on the contrary, part of a small trend."

The most virulent strain, HIV-1, came from our closest relative: the chimp.

Infections that have jumped from other animals also include all influenzas, SARS, Ebola, West Nile, and the mouse-borne hantavirus that made headlines in the summer when it killed three people who had camped in Yosemite National Park.

Quammen is well known for his writings on natural history and evolution. And though virology might seem like a departure for him, "Spillover is really an evolutionary tale, Quammen said.

And indeed, the book unravels the evolutionary story of AIDS and other infectious diseases that seemed to have come out of nowhere. Both viruses and hosts are in a constant state of intertwined evolution, but viruses have an advantage, since they can evolve many times faster than we can.

When scientists discover a new viral disease in humans, Quammen explained, they go searching for the source, the so-called reservoir species in which viruses can lurk.

The reservoir species may or may not get sick from the infection, said Sydney's Holmes, who also read "Spillover and found it "brilliant." He said viruses will evolve to maximize their replication rate, which may mean staying silent or causing illness.

Spillover, Holmes said, is another adaptation that can allow a virus to spread through a whole new population. But they cross much more easily between closely related species because they get into cells through a lock-and-key mechanism, he said, and the keys fit best in similar locks.

Plant or fish viruses are very unlikely to infect us: "We ingest buckets of plant viruses every time we eat a salad," he said.

Passing from birds to humans is possible but difficult, but from our fellow mammals, it is much easier, even more so from our fellow primates: apes and monkeys.

In Quammen's first chapter, he describes a textbook spillover case of a deadly virus that spread through both horses and a few humans in

Australia starting in 1994.

Scientific sleuths traced it to fruit bats. Perhaps, he said, as the bats lost much of their native forest habitat, they were increasingly moving to orchards and other areas nearer to human habitations, including a fig tree under which a horse named Drama Series liked to graze.

It would be easy enough for her to have eaten grass that was contaminated with infectious bat droppings or urine. All anyone knows is that within 24 hours, she developed fever, her face swelled, and she began expelling bloody froth before collapsing and dying.

Soon, other horses in Australia were dying from similar symptoms. One of the stable hands who cared for Drama Series died as well, and some of the other people who tended to the sick horses became ill but recovered.

Quammen said he learned the most from researching his chapter on AIDS. It starts in the 1980s, when doctors recorded a mysterious infection striking gay men in Los Angeles, San Francisco, New York, and Miami.

The history of HIV, however, goes back much further in time.

Through scientific detective work, researchers eventually traced the disease to several strains of a virus, the most rampant and deadly of which, HIV-1, jumped from chimpanzees to humans in Cameroon sometime before 1908. Scientists traced a rarer, milder strain, HIV-2, to an African monkey called a sooty mangabey.

Quammen describes several false leads. At one point a prominent Philadelphia medical researcher, Hilary Koprowski, was wrongly accused of starting the epidemic in the late 1950s by administering a

polio vaccine that was allegedly contaminated with infected chimp tissue.

That speculation has been roundly discredited by several lines of evidence, said Quammen, including genetic analysis showing that the virus must have jumped to humans decades before anyone was experimenting with polio vaccines.

And the future? "Experts agree with near certainty that there will be a next big one," Quammen said. The question, he said, is how long it will take and whether millions or tens of millions of people will die. It depends, he said, on how fast scientists can identify and contain an infection; it will be a race between the disease and human ingenuity.

On a positive note, experts say it's unlikely that the next pandemic will wipe out the human race. "The science has advanced so much in the last 5 to 10 years," said Holmes. "Now we can identify the cause of an infection in 24 hours," he said. "With HIV it took two years."

Note to readers: This is my last evolution column. After 17 years, I will be leaving The Inquirer for a new science writing venture.

It is a great privilege to work as a journalist, but for me, it's even greater to be able to apply journalism to science. The reader reaction - and engagement - has been inspiring and it shows how science feeds the imagination and extends our understanding of our place on earth. Thanks for your many insightful contributions.