

Dear all,

The origin of HIV and AIDS has puzzled scientists ever since the illness first came to light in the early 1980s. For over twenty years it has been the subject of fierce debate and the cause of countless arguments, with everything from a promiscuous flight attendant to a suspect vaccine programmed being blamed. So what is the truth? Just where did AIDS come from?

The first recognized cases of AIDS occurred in the USA in the early 1980. A number of gay men in New York and San Francisco suddenly began to develop rare opportunistic infections and cancers that seemed stubbornly resistant to any treatment. At this time, AIDS did not yet have a name, but it quickly became obvious that all the men were suffering from a common syndrome.

The discovery of HIV, the Human Immunodeficiency Virus, was made soon after. While some were initially resistant to acknowledge the connection (and indeed some remain so today), there is now clear evidence to prove that **HIV causes AIDS**. So, in order to find the source of AIDS, it is necessary to look for the origin of HIV, and find out how, when and where HIV first began to cause disease in humans. Today we are sharing with you an article which describes the basic theories regarding origin of HIV.

As this article is basically of scientific interest. Our focus should be on the current situation of the epidemic, not on the origin of the disease. Instead of diverting attention to the origin of the problem we have to prepare ourselves to fight the epidemic on all grounds. Our knowledge regarding HIV & AIDS is not saturated as required; hence we have to put more efforts to gain knowledge regarding HIV & AIDS. Also it is not necessary that Resource Centre agrees with the theories regarding origin of HIV.

Origin of HIV

HOW?

What type of virus is HIV?

HIV is a lentivirus, and like all viruses of this type, it attacks the immune system. Lent viruses are in turn part of a larger group of viruses known as retroviruses. The name 'lentivirus' literally means 'slow virus' because they take such a long time to produce any adverse effects in the body. They have been found in a number of different animals, including cats, sheep, horses and cattle. However, the most interesting lentivirus in terms of the investigation into the origins of HIV is the Simian Immunodeficiency Virus (SIV) that affects monkeys.

So did HIV come from an SIV?

It is now generally accepted that HIV is a descendant of a Simian Immunodeficiency Virus because certain strains of SIVs bear a very close resemblance to HIV-1 and HIV-2, the two **types of HIV**.

HIV-2 for example corresponds to *SIVsm*, a strain of the Simian Immunodeficiency Virus found in the sooty mangabey (also known as the green monkey), which is indigenous to western Africa.

The more virulent, pandemic strain of HIV, namely HIV-1, was until recently more difficult to place. Until 1999, the closest counterpart that had been identified was *SIVcpz*, the SIV found in chimpanzees. However, this virus still had certain significant differences from HIV.

What happened in 1999?

In February 1999 a group of researchers from the University of Alabama announced that they had found a

type of SIVcpz that was almost identical to HIV-1. This particular strain was identified in a frozen sample taken from a captive member of the sub-group of chimpanzees known as Pan troglodytes (*P. t. troglodytes*), which were once common in west-central Africa.

The researchers (led by Paul Sharp of Nottingham University and Beatrice Hahn of the University of Alabama) made the discovery during the course of a 10-year long study into the origins of the virus. They claimed that this sample proved that chimpanzees were the source of HIV-1, and that the virus had at some point crossed species from chimps to humans.

Their final findings were published two years later in *Nature* magazine. In this article, they concluded that wild chimps had been infected simultaneously with two different simian immunodeficiency viruses which had "viral sex" to form a third virus that could be passed on to other chimps and, more significantly, was capable of infecting humans and causing AIDS.

These two different viruses were traced back to a SIV that infected red-capped mangabeys and one found in greater spot-nosed monkeys. They believe that the hybridisation took place inside chimps that had become infected with both strains of SIV after they hunted and killed the two smaller species of monkey.

They also concluded that all three 'groups' of HIV-1 - namely Group M, N and O - came from the SIV found in *P. t. troglodytes*, and that each group represented a separate crossover 'event' from chimps to humans.

How could HIV have crossed species?

It has been known for a long time that certain viruses can pass between species. Indeed, the very fact that chimpanzees obtained SIV from two other species of ape shows just how easily this crossover can occur. As animals ourselves, we are just as susceptible. When a viral transfer between animals and humans takes place, it is known as zoonosis.

Below are some of the most common theories about how this 'zoonosis' took place, and how SIV became HIV in humans:

The 'Hunter' Theory

The most commonly accepted theory is that of the 'hunter'. In this scenario, SIVcpz was transferred to humans as a result of chimps being killed and eaten or their blood getting into cuts or wounds on the hunter. Normally the hunter's body would have fought off SIV, but on a few occasions it adapted itself within its new human host and become HIV-1. The fact that there were several different early strains of HIV, each with a slightly different genetic make-up (the most common of which was HIV-1 group M), would support this theory: every time it passed from a chimpanzee to a man, it would have developed in a slightly different way within his body, and thus produced a slightly different strain.

An article published in *The Lancet* in 2004, also shows how retroviral transfer from primates to hunters is still occurring even today. In a sample of 1099 individuals in Cameroon, they discovered that ten (1%) were infected with SFV (Simian Foamy Virus), an illness which, like SIV, was previously thought only to infect primates. All these infections were believed to have been acquired through the butchering and consumption of monkey and ape meat. Discoveries such as this have led to calls for an outright ban on bushmeat hunting to prevent simian viruses being passed to humans.

The Oral Polio Vaccine (OPV) theory

Some other rather controversial theories have contended that HIV was transferred iatrogenically (i.e. via medical experiments). One particularly well-publicized idea is that polio vaccines played a role in the transfer.

In his book, *The River*, the journalist Edward Hooper suggested that HIV could be traced to the testing of an oral polio vaccine called Chat, given to about a million people in the Belgian Congo, Ruanda and Urundi in the late 1950s. To be reproduced, live polio vaccine needs to be cultivated in living tissue, and Hooper's belief is that Chat was grown in kidney cells taken from local chimps infected with SIVcmz. This, he claims, would have resulted in the contamination of the vaccine with chimp SIV, and a large number of people subsequently becoming infected with HIV-1.

However, in February 2000 the Wistar Institute in Philadelphia (one of the original places that developed the

Chat vaccine) announced that it had discovered in its stores a phial of polio vaccine that had been used as part of the program. The vaccine was subsequently analysed and in April 2001 it was announced that no trace had been found of either HIV or chimpanzee SIV. A second analysis confirmed that only macaque monkey kidney cells, which cannot be infected with SIV or HIV, were used to make Chat. While this is just one phial of many, most have taken its existence to mean that the OPV vaccine theory is not possible.

The fact that the OPV theory accounts for just one (group M) of several different groups of HIV also suggests that transferral must have happened in other ways too.

The final element that suggests that the OPV theory is not credible as the sole method of transmission is the argument that HIV existed in humans before the vaccine trials were ever carried out. More about when HIV came into being can be found below.

The Contaminated Needle Theory

This is an extension of the original 'hunter' theory. In the 1950s, the use of disposable plastic syringes became commonplace around the world as a cheap, sterile way to administer medicines. However, to African healthcare professionals working on inoculation and other medical programmes, the huge quantities of syringes needed would have been very costly. It is therefore likely that one single syringe would have been used to inject multiple patients without any sterilisation in between. This would rapidly have transferred any viral particles (within a hunter's blood for example) from one person to another, creating huge potential for the virus to mutate and replicate in each new individual it entered, even if the SIV within the original person infected had not yet converted to HIV.

The Colonialism Theory

The colonialism or 'Heart of Darkness' theory is one of the more recent theories to have entered into the debate. It is again based on the basic 'hunter' premise, but more thoroughly explains how this original infection could have led to an epidemic. It was first proposed in 2000 by Jim Moore, an American specialist in primate behaviour, who published his findings in the journal *AIDS Research and Human Retroviruses*.

During the late 19th and early 20th century, much of Africa was ruled by colonial forces. In areas such as French Equatorial Africa and the Belgian Congo, colonial rule was particularly harsh and many Africans were forced into labour camps where sanitation was poor, food was scarce and physical demands were extreme. These factors alone would have been sufficient to create poor health in anyone, so SIV could easily have infiltrated the labour force and taken advantage of their weakened immune systems to become HIV. A stray and perhaps sick chimpanzee with SIV would have made a welcome extra source of food for the workers.

Moore also believes that many of the labourers would have been inoculated with unsterile needles against diseases such as smallpox (to keep them alive and working), and that many of the camps actively employed prostitutes to keep the workers happy, creating numerous possibilities for onward transmission. A large number of labourers would have died before they even developed the first symptoms of AIDS and those that did get sick would not have stood out as any different in an already disease-ridden population. Even if they had been identified, all evidence (including medical records) that the camps existed was destroyed to cover up the fact that a staggering 50% of the local populations were wiped out there.

WHEN?

During the last few years it has become possible not only to determine whether HIV is present in a blood or plasma sample, but also to determine the particular subtype of the virus. Studying the subtype of virus of some of the earliest known instances of HIV infection can help to provide clues about the time it first appeared in humans and its subsequent evolution.

Three of the earliest known instances of HIV infection are as follows:

1. A plasma sample taken in 1959 from an adult male living in what is now the Democratic Republic of Congo.
2. HIV found in tissue samples from an American teenager who died in St. Louis in 1969.

3. HIV found in tissue samples from a Norwegian sailor who died around 1976.

A 1998 analysis of the plasma sample from 1959 has suggested⁸ that HIV-1 was introduced into humans around the 1940s or the early 1950s; much earlier than previously thought. Other scientists have dated the sample to an even earlier period - perhaps as far back as the end of the 19th century.

In January 2000 however, the results of a new study presented at the 7th Conference on Retroviruses and Opportunistic Infections, suggested that the first case of HIV-1 infection occurred around 1930 in West Africa. The study was carried out by Dr Bette Korber of the Los Alamos National Laboratory. The estimate of 1930 (which does have a 15 year margin of error) was based on a complicated computer model of HIV's evolution. If accurate, it means that HIV was in existence before many scenarios (such as the OPV and conspiracy theories) suggest.

What about HIV-2? When did that get passed to humans?

Until recently, the origins of the HIV-2 virus had remained relatively unexplored. HIV-2 is thought to come from the SIV in Sooty Mangabeys rather than chimpanzees, but the crossover to humans is believed to have happened in a similar way (i.e. through the butchering and consumption of monkey meat). It is far rarer, significantly less infectious and progresses more slowly to AIDS than HIV-1. As a result, it infects far fewer people, and is mainly confined to a few countries in West Africa.

In May 2003, a group of Belgian researchers led by Dr. Anne-Mieke Vandamme, published a report in Proceedings of the National Academy of Science. By analyzing samples of the two different subtypes of HIV-2 (A and B) taken from infected individuals and SIV samples taken from sooty mangabeys, Dr Vandamme concluded that subtype A had passed into humans around 1940 and subtype B in 1945 (plus or minus 16 years or so). Her team of researchers also discovered that the virus had originated in Guinea-Bissau and that its spread was most likely precipitated by the independence war that took place in the country between 1963 and 1974 (Guinea-Bissau is a former Portuguese colony). Her theory was backed up by the fact that the first European cases of HIV-2 were discovered among Portuguese veterans of the war, many of whom had received blood transfusions or unsterile injections following injury, or had possibly frequented local prostitutes.

WHERE?

The question of exactly where the transfer of HIV to humans took place, and where the 'epidemic' officially first developed has always been controversial. Some have suggested that it is dangerous to even try to find out, as AIDS has frequently been blamed on an innocent person or group of individuals in the past. However, scientists remain keen to find the true origin of HIV, as most agree it is important to understand the virus and its epidemiology in order to fight it.

Given the evidence we have already looked at, it seems highly likely that Africa was indeed the continent where the transfer of HIV to humans first occurred (monkeys from Asia and South America have never been found to have SIVs that could cause HIV in humans). In May 2006, the same group of researchers who first identified the Pan troglodytes troglodytes strain of SIVcpz, announced that they had narrowed down the location of this particular strain to wild chimpanzees found in the forests of Southern Cameroon. By analyzing 599 samples of chimp droppings (P. T. troglodytes are a highly endangered and thus protected species that cannot be killed or captured for testing), the researchers were able to obtain 34 specimens that reacted to a standard HIV DNA test, 12 of which gave results that were virtually indistinguishable from the reactions created by human HIV. The researchers therefore concluded that the chimpanzees found in this area were highly likely the origin of both the pandemic Group M of HIV-1 and of the far rarer Group N. The exact origins of Group O however remain unknown.

HIV Group N principally affects people living in South-central Cameroon, so it is not difficult to see how this outbreak started. Group M, the group that has caused the worldwide pandemic, was however first identified in Kinshasa, in the Democratic Republic of Congo. It is not entirely clear how it transferred from Cameroon to Kinshasa, but the most likely explanation is that an infected individual traveled south down the Sangha river that runs through Southern Cameroon to the River Congo and then on to Kinshasa, where the Group M epidemic probably began.

Just as we do not know exactly who spread the virus from Cameroon to Kinshasa, how the virus spread from Africa to America is also not entirely clear. However, recent evidence suggests that the virus may have arrived via the Caribbean island of Haiti.

Why is Haiti significant?

The AIDS epidemic in Haiti first came to light in the early 1980s, at around the same time that cases in the USA were being uncovered. Following the discovery of a number of Haitians with Kaposi's Sarcoma and other AIDS-related conditions, medical journals and books began to claim that AIDS had come from Haiti, and that Haitians were responsible for the AIDS epidemic in the United States.

These claims, which were often founded on dubious evidence, fuelled pre-existing racism in the US and many Haitians suffered severe discrimination and stigmatisation as a result. A large number of Haitian immigrants living in the US lost their jobs and were evicted from their homes as Haitians were added to homosexuals, haemophiliacs and heroin-users to make the 'Four-H Club' of groups at high risk of AIDS.

The emotionally-charged culture of blame and prejudice that surrounded HIV and AIDS in the early years meant that it soon became politically very difficult to present epidemiological findings in a neutral and objective way. For many years the link between Haiti and the US epidemic was therefore dropped as a subject.

In March 2007 however, it returned to the public eye at the Fourteenth Conference on Retroviruses and Opportunistic Infections (CROI) in Los Angeles. A group of international scientists presented data based on complex genetic analysis of 122 early samples of HIV-1, group M, subtype B (the most common strain found in the USA and in Haiti) showing that the strain had probably been brought to Haiti from Africa by a single person in around 1966; a time when many Haitians would have been returning from working in the Congo.

The genetic analysis then shows that the virus spread slowly from person to person on the island, before being transferred to the US, again probably by a single individual, at some point between 1969 and 1972.

From this point on, the epidemic would have grown fairly rapidly, with transmission occurring within and between the US and Haiti, and internationally, until the original route taken by the virus was largely obscured.

Dr Michael Worobey, lead researcher in the study, claimed that his data was not intended to place any blame on Haiti, and stressed that none of the people who first transmitted HIV would have been aware they were infected. His work still received strong protests from one Haitian delegate at the conference however, demonstrating the extent to which tracing HIV's origins remains a politically sensitive exercise.

What caused the epidemic to spread so suddenly?

There are a number of factors that may have contributed to the sudden spread of HIV, most of which occurred in the latter half of the twentieth century.

Travel

Both national and international travel undoubtedly had a major role in the initial spread of HIV. In the US, international travel by young men making the most of the gay sexual revolution of the late 70s and early 80s would certainly have played a large part in taking the virus worldwide. In Africa, the virus would probably have been spread along truck routes and between towns and cities within the continent itself. However, it is quite conceivable that some of the early outbreaks in African nations were not started by Africans infected with the 'original' virus at all, but by people visiting from overseas where the epidemic had been growing too. The process of transmission in a global pandemic is simply too complex to blame on any one group or individual.

Much was made in the early years of the epidemic of a so-called 'Patient Zero' who was the basis of a complex "transmission scenario" compiled by Dr. William Darrow and colleagues at the Centre for Disease Control in the US. This epidemiological study showed how 'Patient O' (mistakenly identified in the press as 'Patient Zero') had given HIV to multiple partners, who then in turn transmitted it to others and rapidly

spread the virus to locations all over the world. A journalist, Randy Shilts, subsequently wrote a book based on Darrow's findings, which named Patient Zero as a gay Canadian flight attendant called Gaetan Dugas. For several years, Dugas was vilified as a 'mass spreader' of HIV and the original source of the HIV epidemic among gay men. However, four years after the publication of Shilts' article, Dr. Darrow repudiated his study, admitting its methods were flawed and that Shilts' had misrepresented its conclusions.

While Gaetan Dugas was a real person who did eventually die of AIDS, the Patient Zero story was not much more than myth and scaremongering. HIV in the US was to a large degree initially spread by gay men, but this occurred on a huge scale over many years, probably a long time before Dugas even began to travel.

The Blood Industry

As blood transfusions became a routine part of medical practice, an industry to meet this increased demand for blood began to develop rapidly. In some countries such as the USA, donors were paid to give blood, a policy that often attracted those most desperate for cash; among them intravenous drug users. In the early stages of the epidemic, doctors were unaware of how easily HIV could be spread and blood donations remained unscreened. This blood was then sent worldwide, and unfortunately most people who received infected donations went on to become HIV positive themselves.

In the late 1960's haemophiliacs also began to benefit from the blood clotting properties of a product called Factor VIII. However, to produce this coagulant, blood from hundreds of individual donors had to be pooled. This meant that a single donation of HIV+ blood could contaminate a huge batch of Factor VIII. This put thousands of haemophiliacs all over the world at risk of HIV, and many subsequently contracted the virus.

Drug Use

The 1970s saw an increase in the availability of heroin following the Vietnam War and other conflicts in the Middle East, which helped stimulate a growth in intravenous drug use. This increased availability and together with the development of disposable plastic syringes and the establishment of 'shooting galleries' where people could buy drugs and rent equipment, provided another route through which the virus could be passed on.

CONCLUSIONS

It is likely that we will never know who the first person was to be infected with HIV, or exactly how it spread from that point forwards. Scientists investigating the possibilities often become very attached to their individual 'pet' theories and insist that theirs is the only true answer, but the spread of AIDS could quite conceivably have been induced by a combination of many different events. Whether through injections, travel, wars, colonial practices or genetic engineering, the realities of the 20th Century have undoubtedly had a major role to play. So perhaps what the scientific community should now be focusing on is not how the AIDS epidemic originated, but how those it affects can be treated, how the further the spread of HIV can be prevented and how the world can be changed to ensure a similar pandemic never occurs again.

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