Polio Vaccines and the Origin of AIDS: The Career of a Threatening Idea

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When a virus from one species is able to survive in a different species, at first it is often quite virulent in the new species. For example, the myxoma virus causes little problem in the South American forest rabbit, its longstanding host, but it was devastating when introduced among European rabbits in Australia. As the virus rampages through the new species, susceptible individuals are killed, whereas the resistant ones survive and reproduce, and eventually virulence declines, as in the case of myxomatosis in Australia.[1]

Thus, when a new viral disease springs unannounced on humans, one possible suspect is animal viruses. In the case of AIDS, this soon became the most favored explanation among scientists. In 1983, Luc Montagnier and his colleagues reported isolation of a virus, later called human immunodeficiency virus or HIV, linked to AIDS. Two years later, a type of virus very similar to HIV was found in African monkeys. It was called simian immunodeficiency virus or SIV. Many SIVs cause no obvious disease in their host species, though they can be virulent if transmitted to a different, unaffected monkey species. The obvious explanation for AIDS was that SIV somehow was transmitted to humans, where it became or evolved to HIV.

The next question was how the SIV might have been transmitted from simians to humans. Before looking at the possible explanations, it is worth mentioning some other evidence. First, there are two major types of HIV, called HIV-1 and HIV-2. HIV-1 is the type found throughout most of the world; HIV-2 is found mostly in western Africa.

There are also different SIVs, and in fact new ones continue to be discovered. There is one known SIV that is very similar to HIV-2, but none yet proven to be highly similar to HIV-1.

HIV, like any virus, has a genetic structure. Even within one type of HIV, such as HIV-1, there are many variations. In other words, the genetic structure is pretty much the same, but there are slight variations. The variations are due to mutations and selection as the virus spreads. By examining the spread of variants and working backwards, it is possible to estimate when HIV-1 first entered the human species. The usual estimate is just before 1960.

The other relevant information is evidence of AIDS in humans. One of the earliest known cases has been traced to Kinshasa in Africa in the late 1950s. The implication is that SIV entered humans in central Africa in or by the late 1950s and thereafter spread to other parts of the world.

But how did SIV enter humans? This is of more than intellectual interest. Knowing the process may help to prevent recurrences and to provide clues for developing a cure.

It is known that HIV does not survive easily outside the body and that the most effective means of transmission are via blood or mucosa. One explanation is that a hunter, in butchering a monkey, allowed monkey blood to enter a cut. Others are that a human ate some undercooked monkey meat, that monkey blood was injected into humans as part of certain sexual customs, and that a monkey bit a human.

An explanation along these lines is the standard view on the origin of AIDS. But there is one obvious question. Why did AIDS develop in the 1950s? A cut hunter or monkey bite could have occurred any time in the past thousands of years. The usual explanation is that urbanization and travel led to the wider spread of AIDS beginning in the 1950s.

There is, though, another theory available, that explains both the transmission and the timing: polio vaccination campaigns in central Africa in the late 1950s. This theory is simple and obvious. Polio vaccines are cultured on monkey kidneys. Many of the monkeys would have been carrying SIVs, and many of them would have shown no symptoms and thus not been rejected as ill. Thus it would not be too difficult for some batches of vaccine to be contaminated with SIVs. Since the SIVs were not discovered until 1985, there was no way to screen for them in the 1950s.

There is even a precedent for monkey-human viral transmission. In the early 1960s, some polio vaccines were found to be contaminated with a simian virus named SV40. This caused great concern at the time, since SV40 had been given to tens of millions of people in the United States and elsewhere. Henceforth, steps were taken to screen all vaccines for SV40 and other such viruses. (The health consequences of SV40 in humans is a separate issue that deserves study.)

So here was a theory waiting to be developed and tested. Polio vaccines were already known to have led to the spread of simian viruses to humans. Monkeys with SIVs were almost certainly used in polio vaccine preparation, and there was no screening for the SIVs. Finally, some of the earliest known cases of AIDS were near to the time and location of major polio ➤

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vaccination campaigns, in Africa in the late 1950s.

But this theory was not investigated by the medical research establishment. There is one obvious reason for this: the theory, if accepted as true, would be extremely damaging to the image of medical science. The theory might have been talked about but not seriously studied, as indicated by a report early in 1992: "A senior AIDS researcher said it has been an open secret to many AIDS researchers for at least four years that polio vaccines might have been contaminated by HIV or a related retrovirus," but no testing of vaccine stocks had occurred because, according to this researcher, "Everybody was afraid there would be a public panic or a scandal."[2]

Pascal's Studies

If the medical research establishment was reluctant to investigate the theory, others were not. One of them was Louis Pascal, an independent scholar in New York City. In 1987, he heard a radio talk show with guest Eva Lee Snead who proposed that polio vaccine contaminated with SV40 was responsible for AIDS. Pascal knew enough biology to realize that SV40 couldn't be the cause, but what about the SIVs? He decided to investigate.

By reading medical journals from the 1950s and 1960s and making comparisons with recent reports about the development of AIDS, Pascal soon had a powerful set of arguments suggesting that polio vaccination campaigns in Africa may have led to AIDS. He focussed on a particular batch of vaccine used by Hilary Koprowski, a pioneer in polio eradication but less well known than Jonas Salk and Albert Sabin. Koprowski's CHAT Type 1 polio vaccine was given to some 325,000 men, women and children in central and west Africa from 1957 to 1960, plus a few thousand people elsewhere, such as Poland. Pascal found a remarkable geographical coincidence. The main use of CHAT was in central Africa, not far from the area of Africa with one of the highest incidences of AIDS in the world today. Significant doses of CHAT were also administered in the city of Leopoldville; today that city, now called Kinshasa, has an extremely high incidence of AIDS. Sabin later found this batch of vaccine to be contaminated by an unidentified virus.

Koprowski's vaccine was administered orally, by spraying a mist of vaccine into a person's mouth. This seems to raise an immediate objection: HIV, some later critics said, has not been shown to be transmitted orally, so it is unlikely that SIV could be transmitted to humans this way. Pascal has two responses. First, HIV *can* be transmitted orally, most clearly from breast-feeding mothers to their children. All that is required is that the mucus in a recipient's mouth have reduced immune response. Second, it is quite possible that some of the recipients of the vaccine had ulcers or cuts in their mouths, allowing SIV to enter the bloodstream.

Pascal's main interest was to track the origin of HIV-1. He attributes it to an undiscovered SIV that infected a small number of people in central Africa via Koprowski's CHAT vaccine, followed by the spread of HIV-1 elsewhere via person-to-person contact.

Pascal had one further argument. He notes that the immune system normally resists alien cells, or indeed any biological material with an unfamiliar genetic sequence. This of course is why it is necessary to suppress the immune system when transplanting organs. Pascal asks rhetorically, how better to spread a virus from one species to another than by giving it to large numbers of individuals, some of whom are likely to have impaired immune systems? He then points out that Koprowski's vaccine was given to large numbers of children, some of whom were less than 30 days old. Not only are young children's immune systems undeveloped; the youngest children were given 15 times the adult dosage of polio vaccine.

Pascal found much else in his search through the medical literature, enough to convince him that this theory was worth testing because of its serious implications. One immediate implication is that vaccines should not be cultured on monkey kidneys. There are a number of different SIVs and new ones continue to be discovered. Pascal speculated that a new SIV might be entering the human species every few years, potentially leading to a new type of HIV and causing the death of a million or more additional people. Because different HIVs have different rates of exponential spread, one or two types will usually dominate infection statistics. Nevertheless, the human consequences of a single further new HIV are considerable. Therefore, Pascal thought his theory deserved urgent consideration. After all, a delay of a few years might conceivably lead to the deaths of millions of people.

Another implication of Pascal's theory is the need for an urgent assessment of other possible methods for spreading disease from one species to another. One example is the recently carried-out transplantation of a baboon liver into a human. This provides an ideal opportunity for the spread of any virus in the baboon to the human, given the mixing of cells and blood and the use of drugs to suppress the recipient's immune system. Another example is some of the experiments with genetic engineering.

Pascal had a theory and had good reason to believe it deserved urgent consideration. If the theory could be proved wrong, then there was nothing to worry about; but if it proved correct (or possibly correct) then its implications should be dealt with immediately. He assumed that since the theory seemed so obvious, there would be others who would come up with it independently. But, just in case, he did what he could to make sure it received critical examination.

Pascal believed that if he wrote up his findings and sent them to scientists and to scientific journals, then – taking into account the important potential social implications of the theory – scientists would either refute his ideas or accept them. In other words, he expected his ideas to be considered objectively, irrespective of who he was or how he wrote up his material. Proceeding on this assumption, Pascal wrote an account of his theory, including plenty of references and logical argumentation so that others could check his facts and inferences. He sent his paper to a number of prominent scientists for their examination and also submitted it to a number of leading scientific journals.

From the prominent scientists, Pascal received only one cursory acknowledgment. From the scientific journals – *Nature, Lancet* and *New Scientist* – he received the brush-off, either a rejection with little or no explanation, or year-long failures to answer.

Pascal thought that scientists and scientific journals would give his ideas a fair hearing. Unfortunately, the standard view that science is objective and open to new ideas – a view that is taught to science students in high school and university and to the general public through many popular treatments – is flawed. The reality is that being taken seriously by the scientific research establishment depends sensitively on who the writer is, what their institutional affiliation is, how they write their paper and, not least, what they have to say. To be taken seriously, it is a great advantage to be an eminent scientist, to write from a prestigious address, to write precisely in the standard journal style, and to say something that is just marginally original and not threatening to any powerful interest group. Pascal, by being an "independent scholar" with no institutional affiliation, by writing in a style that deviated somewhat from the standard passionless prose and not citing prominent scientists in quite the appropriate respectful way, and by presenting a highly threatening proposal, was, it seems, never taken seriously.

Defenders of the system would say that Pascal should have couched his ideas in the standard format. If he wanted to be taken seriously, he had to play the game of scientific publication by the rules. From Pascal's point of view, this sort of attitude misses the point. It was he who was raising a serious issue for science and public health. He felt it was the responsibility of editors to deal with his concerns promptly and effectively. If he was

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wrong, nothing was lost; if he was right, many might suffer. Therefore the "scientific reception system," namely the system by which potential contributions to scientific knowledge are considered, certified and published, was responsible for making sure his ideas received proper consideration, even if he didn't couch them precisely in orthodox form.

Cynically speaking, the system works reasonably well to serve the interests of career scientists, who have a strong incentive to play the game by the rules, since that is the way they obtain publication and thereby obtain jobs, grants and promotions. But Pascal was not seeking a career in science, nor did he particularly care about having his name in print. He was primarily concerned about scientific ideas and the social implications of science. This lack of career motive and personal ambition can seem strange to professional scientists. Likewise the operation of the scientific reception system seems strange, indeed immoral, to someone like Pascal with different motivations and goals.

One of his correspondents, a philosopher, sent Pascal's paper to the *Journal of Medical Ethics,* whose editor then invited Pascal to submit a paper on the ethical issues associated with his case. After much labor, Pascal prepared a new paper, but it was rejected by the *Journal of Medical Ethics* for being too long.

In 1990 I began corresponding with Pascal and was quite impressed by his ideas, his grasp of the issues and his thoroughness. After his paper was rejected by the *Journal of Medical Ethics,* I arranged for it to be published in a working paper series at my university.[3] As soon as it began to be circulated, it generated considerable interest among scientists and others. One of the responses was by the editor of the *Journal of Medical Ethics,* who wrote an editorial explaining why they had rejected it, making known its availability and commenting that Pascal's thesis "is an important and thoroughly argued one and ought to be taken seriously by workers in the AIDS field."[4]

Other Investigators

Pascal had long said that he would not be surprised if others independently developed the same theory, since it was so obvious. As indicated by the quote from the AIDS researchers, it had indeed been considered, but apparently not investigated further because of reservations about the possible implications. Most of the scientific community remained ignorant of the theory, aided by unreceptive journals.

One exception was two South African scientists, Professors Gerasimos Lecatsas and Jennifer J. Alexander. Independently of Pascal, they wrote several letters and short pieces to scientific journals raising the possibility of AIDS arising from polio vaccines. Most of their early submissions were rejected, but not all.[5] However, this airing of the idea in a medical journal did not stimulate others to investigate more deeply. Instead, they were personally attacked in a reply to their letter in the *South African Medical Journal.*

Blaine Elswood, an AIDS activist and employee of the University of California at San Francisco, also developed the same theory independently of Pascal. Elswood worked with medical researcher Raphael Stricker and they prepared a carefully written scientific paper. It was rejected by the *British Medical Journal.* They next tried *Research in Virology.* After being given strong encouragement by Luc Montagnier, months passed. Then, in an apparent reversal, they were asked to shorten the paper, delete most of a section on SV40, and resubmit their material as a letter to the editor. Many more months passed before their letter was finally published.[6] It was followed by a rebuttal from the editorial board of the journal.

Clearly the mainstream scientific journals were not eager to give the theory much visibility. Elswood had anticipated this, and he had encouraged Tom Curtis, a free-lance journalist based in Houston, to investigate. Curtis was enthusiastic. Starting with materials obtained from Elswood, he delved further into the literature and also did interviews with many scientists, including Sabin, Salk, and Koprowski. He wrote a series of important stories in the *Houston Post* and a major piece published in *Rolling Stone.* [7]

Whereas the scientific journals had stalled on the story for years, Curtis' *Rolling Stone* story broke through the usual barriers. It became a news item not only in the press, radio and television, but also a story in the news columns of scientific journals.[8]

Koprowski wrote a response in the form of a letter to the editor of *Science.*[9] Curtis wrote a reply, but *Science* refused to publish it.

The Wistar Institute, headed by Koprowski until 1991, holds seed stocks of polio vaccines. Koprowski had earlier been asked by medical researcher Robert Bohannon to release its vaccines for testing.' If vaccines from the 1950s African campaigns were found to be contaminated by SIVs, this would provide support for the polio vaccine-AIDS theory. But Koprowski failed at first to even answer Bohannon's letters. Bohannon also had little success with similar requests to the Food and Drug Administration.

Curtis' story in *Rolling Stone* made it harder for Wistar to refuse to cooperate. The Institute set up an independent advisory committee to advise it concerning the implications of the theory. The committee

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provided a brief 8-page typed report which concluded that the chance that AIDS had originated from polio vaccination campaigns was "extremely low."[10]

Unfortunately the committee never consulted Pascal, Elswood or Curtis in preparing its report. Even if, *a priori*, the chance of causing AIDS from polio vaccines was quite low, we know now that AIDS did develop somehow. Therefore, the key issue is not the absolute probability of AIDS developing from a particular sequence of events, but the relative probability, namely the probability compared to other ways that AIDS might have developed (cut hunters, monkey bites, and so forth). But the Wistar committee made no such comparisons.

The only bit of real evidence that the committee used to criticize the theory was the case of a Manchester seaman who died in 1959, in retrospect apparently having contracted AIDS. HIV was detected post-mortem. Koprowski, in the letter to *Science*, also made a big issue of the Manchester seaman. Yet there are several possible explanations for this case which reduce its power as an objection to the theory.

First, the test for HIV in the seaman's remains may have been a false positive. In other words, the seaman may not have had AIDS at all, but instead the tests that showed HIV may have been contaminated. Aptly, the first four pages of Pascal's paper deal with how easy it is for cell lines to be contaminated, drawing on the famous case of HeLa.[11] Pascal uses the example to show how easy it is for scientists to slip up and how eager they are to avoid acknowledging their mistakes.

Second, the seaman might have been infected by HIV during a trip to Africa or by contact with other seamen, and then have developed AIDS much more rapidly than usual, especially considering that he was given immune-suppressive drugs.

Third, the seaman might have contracted AIDS via some earlier vaccine experiments from the 1920s to the 1950s, at least one of which involved the injection of live monkey cells into thousands of people.[12] Pascal points out that there is evidence of experiments involving grafts of monkey or chimpanzee organs at least as early as 1916.[13] It is possible that monkey viruses could have been transmitted to humans on one or more of these earlier occasions, leading to anomalous cases of disease. This is compatible with polio vaccination campaigns in Africa being the cause of the AIDS pandemic.

It is now the conventional wisdom in the history and sociology of science that a single piece of evidence is not sufficient to reject a theory. Within any general picture, such as a scientific paradigm, there are always some anomalies. These anomalies are either explained away or ignored so long as there are compensating advantages or insights to be gained from the wider picture. This is not to say that anomalies should be dismissed as trivial. Quite the contrary. But they are not alone sufficient basis to reject a theory.

The importance placed on the Manchester seaman example by opponents of the polio vaccine-AIDS theory, and their lack of examination of alternative explanations, suggests the eagerness with which they have sought ways to dismiss the theory. Curtis' interviews revealed the extreme hostility with which Koprowski, Salk, and Sabin responded to the theory. This is not surprising, considering the strong emotional investment that leading scientists have in their own ideas.[14]

There are of course many other arguments concerning the theory, ranging from the problems of gene sequences, the species of monkeys used in polio vaccine trials, the spread of AIDS in other countries, and much more. The aim here is not to address these complexities but to outline the theory and point out the failure of the mainstream scientific community to confront it adequately.

This failure has an intriguing self-righteous twist. Many scientists look down upon the mass media and consider that science is only proper when it takes place in professional forums. Koprowski, for example, said that "as a scientist, I did not intend to debate Tom Curtis when he presented his hypothesis about the origin of AIDS in *Rolling Stone*."[15] He did condescend to reply after a letter by Curtis appeared in *Science*. In another example, Luc Montagnier supported the decision of *Research in Virology* to request Elswood and Stricker to shorten their paper to a letter to the editor by referring to the "extensive publication" of their views in the "lay press."[16]

This seems rather unfair, since the reason the story obtained attention in the "lay press" first is that scientists, knowing about the theory for some years, declined to investigate it and editors refused to publish submissions to scientific journals. In other words, the relevant scientific community failed to come to grips with a theory that deserved critical attention, even if only to refute it. Then, when individuals outside the scientific mainstream worked on the theory and obtained media coverage, their approach was denigrated.

Nevertheless, some inroads into mainstream practice may yet occur. The Wistar committee, in spite of its assessment of the polio vaccine-AIDS theory as highly unlikely, have recommended that polio vaccine no longer be cultured using monkey kidneys, because "There may well be other monkey viruses that have not yet been discovered that could possibly contaminate vaccine lots."[17] This was exactly the thing that Pascal has been warning about for years. It took an article in *Rolling Stone* for scientists to take it seriously.

The implications are wider than just polio vaccines. All transfers of material from one species to another should be scrutinized. For example, it has recently been found that many cattle in the United States are infected by bovine immunodeficiency-like virus or BIV, which has a genetic structure similar to HIV. This is not a scientific curiosity, Pascal points out, because bovine hemoglobin is being used to manufacture substitutes for human hemoglobin. The danger of introducing new diseases to humans may be low, but at the very least it should be investigated.

Thus, even if the theory is wrong, it may be valuable in leading to discoveries or revised practices that will advance the understanding of AIDS, how to deal with it, or how to prevent similar diseases. That is the most that can be asked of any scientific theory.

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