

Report condemns NIH role in AIDS trials

U.S. and French scientists involved in testing an experimental AIDS vaccine failed to receive proper U.S. government approval and to adequately warn their human volunteers of the risks involved in participating in the vaccine's trial, according to a preliminary National Institutes of Health (NIH) report obtained this week. Moreover, the report asserts that the 10-month investigation reveals "a general failure on the part of the NIH . . . to provide adequate protection for human research subjects."

NIH director Bernadine Healy responded to the internal report last month by directing all NIH research chiefs to submit a list outlining the ethical guidelines used in their studies with human patients. The NIH office that oversees the safety of NIH research has also set a Sept. 13 deadline for Healy to outline an overhaul of NIH procedures for protecting human volunteers.

The new report also recommended additional "minimal actions," including ethics courses for NIH scientists and their collaborators, and the development of standardized written agreements for the sharing of biological materials.

The NIH Office of Protection from Research Risks began the investigation following allegations by Chicago Tribune reporter John Crewdson that French AIDS vaccine trials performed with the aid of U.S. researchers did not conform to federal ethics guidelines. Three out of 57 Zairian volunteers died during a mid-1980s trial of a vaccine made from a genetically engineered AIDS virus. Daniel Zagury at the University of Pierre and Marie Curie in Paris developed the vaccine with help from NIH researchers Robert C. Gallo—the co-discoverer of HIV, the AIDS virus—Bernard Moss and Takis Papas.

NIH regulations that govern the use of humans in research apply not only to studies conducted in the United States but also to those performed in other countries with the assistance of NIH scientists. According to the new report, Zagury and Gallo exhibited "a continuing lack of understanding" of the NIH human subjects regulations.

The report describes nine human-AIDS-vaccine projects that Zagury conducted in France or Zaire. Three projects tested a vaccine that was approved in the United States only for experimental use in animals, the report states; one involved 18 Zairian children. Three other trials analyzed blood samples from patients without first obtaining their informed consent. A seventh project involved some patients taking AZT—even though NIH had not approved a protocol to include such patients. In an eighth study, patients were immunized with pieces of HIV without first being told that they would subsequently test positive on

blood tests for AIDS—despite never having been infected by the virus.

"NIH must be faulted for creating an administrative structure (or vacuum) that has resulted in widespread confusion" about ethical procedures for human subjects, the report states. The NIH scientists "assumed that they had no responsibilities in this area as long as they did not directly inject human beings with experimental materials," the report adds.

Gallo and NIH officials involved in the preparation of the report could not be reached for comment.

NIH is still trying to determine if the breaches of biomedical ethics resulted in harm to any of the studies' participants, according to the report. Because Zagury has refused to share medical records for his studies' volunteers, NIH officials are currently attempting to gain access to the records through diplomatic channels.

Zagury contends the vaccine trials were conducted according to the ethical guidelines of France and Zaire, and that except for the three who died, all of the volunteers remain healthy. He describes as "crazy" NIH's request to send experts to France and Zaire to monitor his patients' medical records. "Do you think French experts would go to NIH to look for American records?", he asks rhetori-

cally. "This is something unbelievable."

French law does not require researchers to gain patients' consent before analyzing their sampled blood, Zagury says. He also denies giving humans any vaccines not approved for human testing. "Of course reagents were not used in humans when it was specified not to use them in humans," he asserts.

In addition, Zagury contends that Gallo, Moss and Papas were not collaborators on his vaccine trials. Therefore, he argues, NIH's ethics rules do not apply. "I deny categorically that NIH scientists were involved" in the tests in France and Zaire, he told *SCIENCE NEWS*. "NIH scientists had no involvement in terms of budgetary participation, research program participation or clinical investigation that might have constituted a scientific collaboration," he asserts. But he acknowledges that NIH researchers provided "intellectual consultations."

The NIH report says Zagury's studies "relied, at least in part, on materials and/or technical expertise provided by NIH scientists."

Midway into the NIH investigation, the agency forbade Gallo from further collaborations with Zagury. NIH director Healy has now forbidden Gallo, Moss and Papas or members of their laboratories from participating in any research projects involving human subjects without special dispensation from NIH. — C. Ezzell

Messages in mathematically scrambled waves

When White House chief of staff John H. Sununu travels, he has with him special equipment to scramble telephone calls and keep communications secure from eavesdroppers. This kind of sophisticated, expensive technology for assuring privacy, however, generally lies beyond the reach of someone who merely wants to keep neighbors from inadvertently listening to or deliberately intercepting conversations over a cellular or portable telephone.

"There are only a few cases where you want to use the best [technology available]," says mathematician and cryptography expert G.R. Blakley of Texas A&M University in College Station. "Just as we put locks on sliding glass doors, we want to be able to enclose certain [information] in envelopes that are relatively inexpensive and keep out casual browsers."

Blakley is one of a small group of computer scientists and mathematicians now exploring the applicability of several mathematical techniques for scrambling analog information—such as a telephone conversation or a television signal—which is represented as a continuous wave rather than digitally as a sequence of numbers. "We're trying to build up a zoo of mathematical choices so that . . . people can search among them to find

things that are both reasonably secure and cost-effective to implement," he says.

Blakley and several other speakers described recent developments in analog cryptography at the International Conference on Industrial and Applied Mathematics, which convened last week in Washington, D.C.

Practically all present-day cryptographic systems for hiding information depend on having signals in a digital form. Scrambling a telephone conversation, for example, requires converting speech into a digital signal, which is then mathematically manipulated to produce the encrypted message.

One possible way to simplify the whole procedure involves working directly with the continuous wave itself, circumventing the time-consuming and costly process of converting the analog signal into a digital form. But finding the right set of mathematical manipulations that not only effectively hide information, but also permit their easy unraveling by a receiver, remains a challenge.

Computer scientist George I. Davida and mathematician Gilbert G. Walter of the University of Wisconsin-Milwaukee have studied several candidates for an analog cryptographic system that would provide a reasonable level of security. One scheme requires applying a so-

Satellites expose myth of marching Sahara

called "integral operator" to a speech signal. This mathematical process takes all the bumps and sudden shifts out of the original waveform. "What comes out is a smoothly varying signal," Walter says. "On an oscilloscope, it doesn't look at all like the original speech signal."

To recover the original speech, the message's authorized receiver applies a differential operator — the inverse of the integral operator — to the encrypted signal, which restores its initial choppy-ness. However, certain integral operators may fail to hide information adequately. The human ear is remarkably resilient, Walter says. "If we aren't careful about the way we choose the integral operator, [an eavesdropper] can still understand what comes through."

Moreover, the overwhelming preponderance of digital equipment in the modern laboratory stymies the testing of analog cryptographic devices. "The problem is that we have to simulate these analog devices by digital means [on a computer], which sort of defeats the purpose," Walter says.

Nevertheless, Davida adds, "we've achieved some remarkable results in the realm of both [information] compression and encryption."

A newer, alternative approach to analog cryptography involves dividing an analog signal into small pieces, then using a relatively new mathematical technique known as wavelet analysis to break each piece up into its components. The idea is that any wave segment can be represented by a suitable collection of fundamental building blocks, or wavelets.

The wavelet technique converts each wave segment into a set of numbers representing how many of each building block are present in the given segment. Scrambling these numbers produces a new, different waveform, which can then be sent as an encrypted message. The receiver, who knows how the numbers were scrambled and which set of wavelets were used as the building blocks, reverses the process to hear the message.

One advantage of using wavelet analysis for cryptography is that the process simultaneously shuffles frequencies and times. The scheme changes not only the order in which pieces of the wave are transmitted but also mixes up the signal's characteristic frequencies.

"I'm really anxious to try this method in the laboratory," Walter says. "I think we can simulate it on a computer."

"We feel rather lonely because not many people are working in this area," Davida says. "I think they have mistakenly abandoned analog systems. I can't imagine analog signals going away entirely."

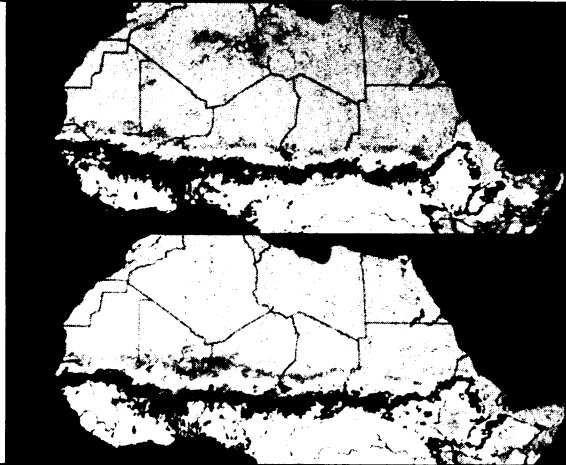
Furthermore, analog cryptographic systems may help lower the cost of assuring privacy, Davida says. "It's worthwhile to have privacy available to anyone who wants it."

— I. Peterson

The expansion of the Sahara desert appears a dramatic example of an environmental crisis: Pictures in the media show towns buried under sand dunes that engulf more and more arable land each year. But satellite measurements over the last decade reveal the march of the Sahara—the largest desert on Earth—is not as widespread or severe as the United Nations and other organizations had supposed.

Reports in the 1970s and 1980s portrayed the southern edge of the Sahara rolling ever southward like a wave, expanding into the sub-Saharan Sahel region at a rate of 5 kilometers per year.

Satellite measurements of north Africa show bands of vegetation shifting north or south in response to rainfall changes. From 1984 (top) to 1985 (bottom) the vegetation moved northward 110 kilometers, reducing the size of the Sahara desert by 724,000 square kilometers.



NASA

International organizations laid much of the blame for this "desertification" on overgrazing and other land use problems.

But vegetation measurements collected every day by U.S. meteorological satellites show that the southern edge of the Sahara ebbed and flowed more like a tide over an 11-year period starting in 1980. Compton J. Tucker and Wilbur W. Newcomb of NASA's Goddard Space Flight Center in Greenbelt, Md., and Harold E. Dregne of Texas Tech University in Lubbock report the observation in the July 19 SCIENCE.

"The message [of these results] is that a lot of what's been claimed about the so-called desertification of the Sahel is just incorrect," says Sharon E. Nicholson, a meteorologist at Florida State University in Tallahassee, who has studied rainfall patterns in Africa.

Previous reports of desert expansion have erred by assuming that trends observed in a few isolated locations were occurring across the entire continent, says Tucker. They also failed to take into account the effect of a drought that plagued the region during the 1970s and 1980s, causing vegetation patterns to shift, he adds.

Meteorological satellites, however, now allow broad regional tracking of the desert's boundary, which Tucker's group defines as the area that receives 200

millimeters of rainfall per year. The scientists gauged precipitation amounts indirectly from the amount of red light reflected off Earth's surface. Because chlorophyll in plants absorbs red light, desert areas reflect more red light than do vegetated regions. Areas of thicker plants correspond to areas that receive greater amounts of rainfall.

The boundary between the arid Sahara and the semi-arid Sahel region migrated appreciably each year during the study period. From 1980 to 1984, the desert expanded southward, with the boundary shifting 240 kilometers (km). But from 1984 to 1985, the trend reversed and the

divider moved north by 110 km in a single year. It moved northward another 30 km the next year. In 1987, the boundary shifted back southward by 55 km, and northward 100 km in 1988. In 1989 and 1990, it shifted southward 77 km.

While the southern extent of the Sahara in 1990 reached 130 km further south than in 1980, that difference does not reflect a long term trend but rather a difference in the year-to-year rainfall, Tucker says. The results suggest researchers will have to measure over a number of decades in order to discern any long-term changes due to human activities, he contends.

During the last decade, reports of desert expansion in the Sahara prompted development programs to provide substantial funds for planting and irrigating rows of trees — an expensive effort designed to stabilize sand dunes. But these agencies are now shifting their focus, in part because of the satellite measurements. "This is the first time that we have had a broad overview of the desert boundary issue," says Ridley Nelson, an agricultural economist with the World Bank in Washington, D.C. Development organizations see desert advancement as less of a problem and are instead addressing practices that lower the productivity of dry land areas, Nelson says.

— R. Monastersky