current filaments. This happens because the electrical resistivity in the avalanche regime decreases with electric field (a special case of a more general phenomenon called negative differential resistance). If, due to a local inhomogeneity, the electric field is larger than average in some region of the material, its resistivity is thus reduced below average. More current flows into the region, and it elongates until it forms a current filament extending all the way through the material (see figure).

These similarities are deceptive, however, as the physics underlying the negative differential resistance is almost certainly very different in the two classes of materials. In conventional semiconductors, its origin is thought to be essentially a single electron effect: As the electric field is increased, a given electron can acquire more energy before it collides with an impurity, and the likelihood of impact ionization increases. By contrast, more complex many-body effects appear to be at work in $Pr_{0.7}Ca_{0.3}MnO_3$.

Indeed, the experimental evidence suggests that the region inside the current filament is characterized not only by a much higher density of free electrons than the surrounding insulating medium but also by a collective ferromagnetic alignment of the local spins, as in the magnetic field–induced equilibrium metallic phase. Some of the most persuasive evidence comes from a different type of experiment, where $Pr_{0.7}Ca_{0.3}MnO_3$ is irradiated by x-rays and hot electrons are generated by photoionization (*5*). In this case, the hot electron-induced metallic phase persists even after the x-ray beam is switched off and can thus be directly compared with the magnetic field–induced phase. Why the conducting phase observed in the electric breakdown experiments (*2*, *6*) does not also persist when the electric field is switched off is one of the puzzles we are left with at this stage.

To understand how hot electrons manage to convert an antiferromagnetic insulator to a ferromagnetic metal, the interaction and thermalization of these electrons with a background of correlated spins need to be systematically addressed. The behavior of these and other magnetic oxides far from equilibrium may well help us develop general concepts for electronic transport in the presence of strong interactions among the various electronic and lattice degrees of freedom, an endeavor that is currently at the frontier of solid-state physics. In the long run, it is also conceivable that magnetic effects induced by hot electrons will be put to work in new generations of electronic devices.

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AIDS

Aligning Science with Politics and Policy in HIV Prevention

Karen Hein

"Spread the word—not the virus" has been a mantra among AIDS activists since the beginning of the HIV epidemic. Educating people about the virus and risk of infection, getting people to behave in ways that reduce risk, and increasing understanding and compassion for those infected are widely accepted societal goals. Efforts to prevent HIV infection have undoubtedly saved many lives, just as new combination therapies have delayed death for many infected individuals. However, the incidence of HIV remains steady (see the figure), a fact that reminds us that more effective preventive measures are needed. Recently, deaths from AIDS have decreased, partially as a result of more effective treatments (see the figure), but new infections continue to rise in many segments of the American population (*1*) and in most segments of developing nations. We can now answer three questions: Does HIV prevention work? If so, why are we not preventing HIV more effectively? How do U.S. efforts to prevent AIDS compare to those of other nations?

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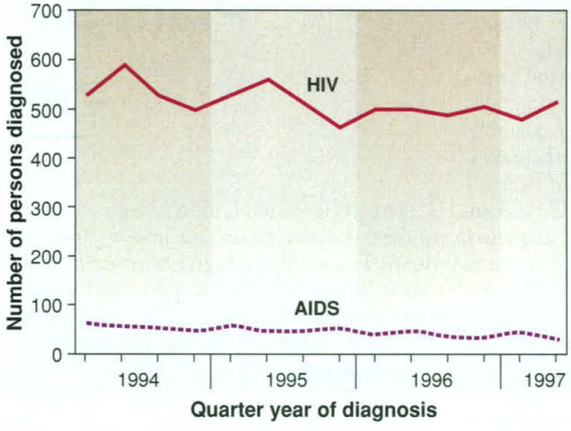

Incidence of AIDS and HIV. Estimated number of persons aged ≥13 years in whom HIV was diagnosed in 25 states in the United States from January 1994 to June 1997 (*1*).

The answer to the first question is, "Yes—but." The scientific bases for preventive interventions have been strengthened as a result of theoretically based, carefully designed studies that have reasonable periods of follow-up and attention to methods and analytic dimensions. Examples include two well-designed studies discussed in this issue. The first, a research article by the National Institute of Mental Health Multisite HIV Prevention Trial Group on page 1889, focuses on individuals at highest risk for HIV in the United States (*2*). The second, described in a Viewpoint on page 1873, is an intervention involving societal and countrywide interventions in Thailand (*3*). Individuals responsible for HIV prevention efforts cannot always act on the results of these studies, because they are unaware of the results or because of barriers in the policy or political arena. One large obstacle in applying research studies to practice has been a reluctance to use scientific findings as a basis for policy because of the perceived political consequences. Three recent examples are (i) reluctance of the U.S. government to permit use of federal funds to support needle exchange programs, (ii) emphasis on "abstinence-only" education, and (iii) controversy about condom advertising.

One effective approach to prevention (*2*) is an intervention aimed at individuals at highest risk for HIV infection. The method was a randomized controlled study of adults recruited from seven sites across the country, involving 37 clinics, with 1855 people assigned to the control group and 1851 to the intervention, which consisted of seven sessions of small group meetings. Follow-up evaluation was

conducted 1 year later and consisted of a behavioral assessment (determining episodes of unprotected intercourse and consistency of condom use) as well as health outcomes, defined by reported and recorded rates of sexually transmitted disease (STD) symptoms and diagnosis of new and repeated infection with chlamydia and gonorrhea. The study design ensured consistency across settings for evaluation and outcome criteria. This study is a good example of a large, well-designed intervention study with an adequate period of follow-up and relevant outcome criteria, including both behavioral and STD end points. This type of intervention, namely small group meetings as a means to alter individual behavior, is one that could be instituted in many health-care settings, including managed care, public programs, and school or community-based settings.

The approach used in Thailand takes this intervention strategy to the next level (*3*). The premise of this HIV prevention process is that changing individual behavior is necessary, but not sufficient, for decreasing the risk of HIV infection. Instead, the focus of the intervention was widened to include the cultural context in which individuals are living. The intervention thus included a strategy to saturate the public with information about the safety and efficacy of condom use, and to use government funding to make 60 million condoms available to the population. The implementation required not only cooperation from the public health sector, but contributions from the social and economic sectors as well. The government invested 2 billion baht in the program in 1997. The rates of HIV infection in two groups were documented before, during, and after the campaign. Rates of infection were rising rapidly before the intervention, fell considerably during the time of the campaign, and are now beginning to rise once again, in part because of the financial crisis in Thailand (and in Asia generally), which has severely curtailed the availability of funds for the continuation of the prevention efforts. So, "Does HIV prevention work?" The answer is, "yes—but one always needs to be able to actually implement the intervention." This requires access to services for evaluation and treatment, a supportive community or environment to enable individuals to actually carry out the healthful behaviors, and the ability to acquire the information, skills, and services to reduce risk.

So why don't we benefit from what we know works? In the United States, politics interfere with science-based policy. The administration recently acknowledged the scientific basis for recommending needle exchange programs as a useful way to reduce HIV transmission by intravenous drug users and their partners, but its withholding of federal funding for these efforts shows the effect of politics. Similarly, Congress assigned $50 million in 1997 for abstinence-only education, at a time when a fuller, more balanced approach was shown to be more effective. Comprehensive family life and sex education with age-appropriate access to condoms is a far better approach to reduce risk-related behaviors in students. In addition, the major television networks continue to ban condom advertisements, despite the recent Kaiser Family Foundation survey showing that 72% of adults support condom commercials on network TV. So a major obstacle to effective HIV prevention is not a dearth of good ideas or scientifically based interventions, but rather political restraints, even where adequate science exists as a basis for policy recommendations.

The answer to the third question is therefore "AIDS prevention efforts in the United States compare poorly to those of other nations." Clearly, the United States has the resources to provide necessary interventions and services suggested by the scientific studies of HIV prevention. Now is an appropriate time to question both the cost and quality of HIV prevention efforts, but there is little evidence that the United States is doing so (*4*). Other countries, such as Switzerland, Australia, and most Western industrialized nations, have far lower HIV rates and unintended pregnancy and STD rates than those reported in the United States. One study of the cost-effectiveness of HIV preventive efforts compared three interventions (*5*). The study examined the estimated cost per HIV infection averted. Variables included the number of uninfected individuals, the incidence of HIV, the effectiveness in reductions in risk behaviors, and the estimated number of HIV infections averted. The results pointed to clear differences in cost-effectiveness: $2,667 for needle exchange for injection-drug users (in New York City); $12,000 to train community leaders (in Biloxi, Mississippi); and $194,186 for HIV testing of surgeons. The United States has the money but does not invest it wisely, according to this analysis. Scientifically based prevention strategies exist, they work, and they are available to scale up to larger populations—but only if we can align policy and politics with the current science of HIV prevention.

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PLANT BIOLOGY

How Calcium Enhances Plant Salt Tolerance

Emanuel Epstein

Like cells in general, most plant cells accumulate the ion potassium and exclude sodium. The resulting high potassium/sodium ratios in the cells enable potassium to perform essential functions that sodium cannot fulfill. This selectivity in favor of potassium is especially important in the arid and semi-arid regions of the world, where excess sodium salts in the soil cause widespread and often severe problems for crop production. The sodium may compete with potassium in membrane transport and in functions such as enzyme activation, impairing the ability of the plant to grow. For decades, it has been known that another ion, calcium, is required to maintain or enhance the selective absorption of potassium by plants at high concentrations of sodium (*1*). The mechanisms underlying this crucial action of calcium in protecting plants against the disruptive effects of high sodium concentration have so far eluded us. Now on page 1943 of this issue, a significant advance in our understanding has been made by Liu and colleagues (*2*), who have identified the molecule that likely mediates this calcium protection.

During membrane transport of ions in any plant exposed to saline conditions, potassium/sodium discrimination is critical at several steps (see the figure). Absorption of potassium initially occurs by an epidermal or cortical cell of the root as it is transported across the outer cell membrane or plasmalemma. After this radial transport across the root, the ion is then delivered into the conducting system of the xylem, in

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