need to be *successfully* vaccinated to decrease the rate of HIV reproduction to the same as that attained by the universal (100%) use of condoms? [The reproductive rate (3) is essentially the number of secondary infections arising from each primary infection early in the epidemic.] If each act of sexual intercourse capable of transmitting the virus constitutes an independent Bernoulli trial (4), then ϕ can be approximated by

$$\phi = 1 - \frac{1 - (1 - \alpha\epsilon)^c}{1 - (1 - \alpha)^c}$$

where α denotes the infectivity of HIV (that is, the per-contact probability of transmission from an infected to an uninfected partner), ϵ denotes the condom failure rate, and c is the number of sexual encounters during a sexual relationship of average duration.

If one assumes that $c\alpha$ is not too large, then $(1 - \alpha)^c \approx 1 - c\alpha$, hence

$$\phi = 1 - \epsilon$$

In other words, if condoms are 90% effective in preventing the transmission of HIV, then 90% of the population would have to be successfully vaccinated for society to get the same benefit (the same reduction in the spread of AIDS) as it would from the conscientious use of condoms (5).

Although precise estimates of the failure rate of condoms with respect to HIV transmission are difficult to obtain (6), it appears that the commonly cited figure of 10% is conservative; recent studies indicate a 2% failure rate when condoms are properly used (7). If condoms are, in fact, about 90% effective, it seems reasonable to question whether *any* vaccine could protect the population against HIV infection as well as the consistent use of condoms; θ is the proportion of the population that is *successfully* vaccinated and is therefore the product of the percentage vaccinated and the efficacy of the vaccine. Thus, unless vaccination of the entire population could be ensured, even a 90% effective vaccine would not equal the protection offered by the consistent use of condoms.

The above analysis is oversimplified and assumes a rather unrealistic rate of condom usage (100%). Nevertheless, the take-home message should be clear: biomedical solutions alone cannot defeat AIDS; only humans can. Thus, our prevention "eggs" should be distributed into several "baskets," including producing better condoms and facilitating their use.

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2. S. D. Pinkerton and P. R. Abramson, *Eval. Rev.*, in press.
3. R. M. May and R. M. Anderson, *Nature* **326**, 137 (1987); S. D. Pinkerton and P. R. Abramson, in preparation.
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5. Under conditions of high infectivity, or where this approximation otherwise fails, $\theta < 1 - \epsilon$.
6. M. F. Goldsmith, *J. Am. Med. Assoc.* **257**, 2261 (1987).
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Transportation Costs and the National Debt

In buying a car, one considers many things, including price, comfort, appearance, and a preference for one make rather than another. A consideration in the mind of many purchasers is miles attainable per gallon of fuel, a number that is clearly posted on the price sticker of each new vehicle. What is really important, however, is cents per mile; in other words, how much does it actually cost to own and operate an automobile?

The answer can be readily obtained from *Motor Vehicles Facts and Figures* (1). In this study, ownership costs are based on a 6-year or 60,000-mile retention cycle. All costs, including those for gas and oil, maintenance, tires, insurance, license, registration, depreciation, and finance charges, are included. In 1992, the national average total cost per mile was 45.77¢, which included 5.2¢ per mile for gas and 0.8¢ per mile for oil change charges. Thus, the net cost for gasoline was about 5¢ per mile or about 10% of the total transportation cost of 45.77¢ per mile. This fuel cost is the lowest in recent history and reflects progress in engine efficiency achieved over the last 20 years (2): for all registered cars, the average miles per gallon was 13.3 in 1973 and 17.1 in 1983; the preliminary data indicate 21.7 for 1991.

The impact of an additional gasoline tax should now be considered. The current congressional proposal, after long and tedious debate, centers at about 5¢ per gallon. The effect of this tax on transportation cost would be 5¢ divided by 21.7 (the current average miles per gallon), which equals a 0.23¢-per-mile increase. Thus, instead of 45.77¢ per mile, the new transportation cost would be 46.0¢ per mile, an increase of only 0.5%. The same 5¢ gasoline tax increase, when based on the 1991 consumption of 120 billion gallons of gasoline (3), would bring in $6 billion per year. Thus, in the major drive

behind the proposal for a gasoline tax to reduce the national debt, this sum represents only a small contribution.

Now, suppose that Congress were to increase the tax by 50¢ per gallon. This would increase the transportation cost by 5% from 45.77¢ to 48.07¢ per mile. However, based on 120 billion gallons of gasoline consumption per year, the increased tax of 50¢ would bring in $60 billion toward debt reduction.

It should be recalled that Ross Perot suggested some time ago that a 50¢ per gallon tax increase would not be too large. The basic question is, How serious is the American public in truly wishing to cut the debt? If it is truly serious, it should accept the concept of total transportation cost per mile as a meaningful guideline in the decision process. Should the decision be positive, the public should insist that the $60 billion go only for debt reduction and that "the fox be kept out of the chicken coop."

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References and Notes

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2. *Highway Statistics 1991* (PB93-132520, Federal Highway Administration, U.S. Department of Transportation, Washington, DC, 1993), table VM-1.
3. *Nat. Petrol. News* (mid-June 1993), p. 172.
4. I am appreciative to Else M. Boland of UOP Inc., Des Plaines, IL, for providing much of the data.

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Megaproject Support

Contrary to the article by Faye Flam about the Advanced Neutron Source (ANS) (News & Comment, 23 July, p. 420), I am *not* opposed to the construction of this nuclear reactor. Indeed, I served as a consultant on the 1984 Seitz-Eastman Committee that recommended the ANS as the second highest priority (behind the 6-GeV synchrotron) for materials science facilities. I concurred with that judgment and think it is unfortunate that progress has been so slow on a project of such importance.

I am, as the article correctly states, flabbergasted by the increase in price. Materials scientists, including myself, have not hesitated to criticize the doubling of the cost estimate for the Supercollider. But the estimated cost of the ANS has gone up tenfold, from $260 million in 1984 to $2.7 billion today.

Finally, my comments were made as a materials scientist and had nothing to do with my role in the American Physical Society.

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Recovering Funds

As noted in ScienceScope (4 June, p. 1415), scientist Wasim Siddiqui remains on the payroll of the University of Hawaii at Manoa in the Department of Tropical Medicine after pleading no contest to embezzlement charges. The article states unfairly, however, that university officials have "yet to discipline" the employee for improprieties. The university is handling this matter in accordance with administrative and contractual procedures. Unfortunately, Hawaii state law prohibits us from commenting on the specifics of the case until the matter is fully resolved.

The university has filed a civil action—and placed a lien on Siddiqui's retirement plan—to recover $114,000 in research funds from the U.S. Agency for International Development that were the subject of the criminal charges as well as $250,000 in misappropriated funds. Obviously, the University of Hawaii is interested in speedy resolution of this matter; we will also fulfill our obligation to observe all applicable due process rights.

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Corrections and Clarifications

An asterisk indicating that she was a corresponding author should have appeared next to Catherine C. Hedrick's name in the list of authors of the report "Atherosclerosis in transgenic mice overexpressing apolipoprotein A-II" by C. H. Warden *et al.* (23 July, p. 469).

In Christopher T. Walsh's Perspective "Vancomycin resistance: Decoding the molecular logic" (16 July, p. 308), it is stated incorrectly that "about 95% of *Staphylococcus aureus* isolates are resistant to the β-lactam methicillin." About 95% of *S. aureus* are resistant to penicillin, but the majority (perhaps 70 to 90%) are still sensitive to methicillin.

The Random Sample item, "Russians, U.S. differ on Arctic sub threat" (25 June, p. 1881) should have said that the Sellafield nuclear reprocessing plant has dumped 1 million curies of cesium-137 (not plutonium) into the North Sea. The plant has dumped more than 18,000 curies of plutonium.