Compensating Behavior and the Drug Testing of High School Athletes

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On June 26, 1995, the United States Supreme Court ruled in *Vernonia Sch. Dist. 47J v. Acton* that middle-school and high-school athletes can be required to submit to suspicionless drug tests as a condition of athletic participation (Greenhouse 1995). Although the decision removed a major constitutional roadblock to the adoption of such programs by public schools nationwide, the response was initially tepid: as of January 1996, six months after the ruling, only 1 percent of the country's 16,000 public high schools had implemented random drug-testing programs. For many schools, the financial barrier of drug testing ($20 to $30 per standard drug screen; $100 per steroid test) proved far harder to surmount than the constitutional barrier (Dohrmann 1996).

In the past year, however, the number of schools engaged in drug testing has continued a slow but steady rise. For instance, the high school in Kokomo, Indiana, began subjecting all students who participate in extracurricular activities to random drug testing in April 1996 (Glass 1997: 20), and the city of Oceanside, California, began a drug-testing program for its high-school athletes early in 1997 (Penner 1997). Future improvements in testing technologies that lower costs and increase reliability promise to accelerate the spread of such testing (Reuter 1988: 556).

Not surprisingly, suspicionless drug testing has come under attack from a number of quarters. Civil libertarians (e.g., Shutler 1996) and newspaper editorialists (e.g., Berkow 1995, Goodwin 1995, Bradley 1995) have assailed the Supreme Court decision and condemned random drug testing of student athletes as an unjustified invasion of

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privacy. Physicians have also criticized such testing, arguing that there is little evidence that student athletes are more prone to drug use or abuse than their nonathlete peers (Schnirring 1995: 25).[1] For example, a host of studies has been completed over the past 15 years examining drug use among college athletes (e.g., Toohey and Corder 1981, Anderson and McKeag 1985, Anderson et al. 1991) and college students in general (e.g., Johnston, O'Malley, and Bachman 1988). Table 1 is reproduced from the most recent of these studies. It compares drug use rates for the general college population with drug use rates for varsity athletes from 11 NCAA schools that did not have drug testing programs at the time of the survey. Table 1 strongly suggests that drug use among college athletes is significantly lower than use in the general college population for a whole host of drugs, including alcohol—even in the absence of drug testing.

The data presented in Table 1 suggest a disturbing, previously unnoticed problem with random drug testing of student athletes. Participation in student athletics is strictly voluntary and is likely influenced by the costs (e.g., lost leisure time) and benefits (e.g., prestige) of participation. Drug testing, by invading the privacy of

TABLE 1

DRUG USE BY VARSITY ATHLETES AT 11 NCAA SCHOOLS DURING PREVIOUS 12 MONTHS COMPARED WITH DRUG USE BY GENERAL POPULATION OF COLLEGE STUDENTS (PERCENT)

	Varsity Athletes		College Students	
Drugs	Males (n = 1,552)	Females (n = 730)	Males (n = 520)	Females (n = 700)
Alcohol	90*	87*	93	90
Amphetamines	3**	3**	7	7
Cocaine/Crack	6**	4**	19	14
Marijuana/Hash	29**	25**	41	34

NOTES: Two-sample test of proportions (large sample)—null hypothesis: equal proportions; alternative hypothesis: college student proportion higher than corresponding athlete proportion.

* Difference in proportions significant at 5 percent level.

** Difference in proportions significant at 1 percent level.

SOURCES: Data on varsity athletes from Anderson et al. (1991); data on college students from Johnston, O'Malley, and Bachman (1988). None of the 11 NCAA schools had drug testing programs at the time of the survey (Anderson 1997).

[1]Exceptions to this statement include anabolic steroids, which are performance-enhancing drugs, and smokeless tobacco, which is probably performance-neutral (Schnirring 1995: 25).

student athletes and by making continued drug use difficult or impossible, increases the cost of athletic participation and will most probably lead marginal student athletes to "quit the team." Freed from the regimen of athletics, these former athletes may revert to the drug-use patterns of their nonathlete peers—who have higher rates of drug usage than athletes, according to Table 1.[2] Thus, the imposition of random, suspicionless drug testing on student athletes will have two separate but opposite impacts on drug use:

1. Use will decrease among those inframarginal athletes who continue to participate.
2. Use will likely increase among those marginal athletes who cease to participate.

The net effect on overall student drug use is ambiguous in sign—overall student drug use may fall or rise after the imposition of testing, and any reduction achieved will likely be smaller than expected.

In this paper, I explore the conditions under which the random drug testing of athletes will lead to the perverse outcome of *increased* student drug usage. As I will show below, the threat of this policy backfiring is not fanciful, but rather is quite real and should worry policymakers and others who are concerned with the high level of drug use among students. Civil liberties issues aside, the random drug testing of athletes may be a very risky policy innovation.

I begin the paper with a look at previous studies on the frequency and efficacy of drug testing, most of which are concerned with workplace environments. After pointing out the contrasts between these studies and my own work, I present the paper's formal model, which bears a close resemblance to the models found in the "compensating behavior" literature begun by Peltzman (1975). I conclude with a discussion of the need for caution and careful follow-up studies during the implementation of random drug-testing programs for athletes.

Previous Contributions to the Drug-Testing Literature[3]

One strand of the drug-testing literature examines the effect of drug-test reliability on the decision to do testing (e.g., Sexton and Zilz

[2]I will assume throughout this paper that all of those categorized as "College Students" in Table 1 are nonathletes. Correcting for this problem would merely reinforce the point I wish to make.

[3]This brief survey is not intended to be exhaustive. It focuses almost exclusively on the recent work of economists and other public policy analysts. For a more thorough review of this literature, see Henriksson (1991).

1988, Feinstein 1988). Two types of errors are possible with drug testing: the false positive (fingering a nonuser) and the false negative (missing a user). The decision to test rests not only on these error rates, but also on the costs associated with the two types of errors and the number of users and nonusers in the population of interest. For example, Sexton and Zilz (1988: 545) show that testing will be better than nontesting if and only if:

$$(1)\quad \frac{\textit{Cost of False Negative}}{\textit{Cost of False Positive}} \geq \frac{\textit{Likelihood of False Positive}}{\textit{Likelihood of True Positive}} \times \frac{\textit{Number of Nonusers}}{\textit{Number of Users}}.$$

For a host of drug classes they demonstrate that only under fairly stringent conditions will this inequality hold (ibid.: 546).

A more recent line of research focuses exclusively on drug testing in the workplace. McGuire and Ruhm (1993) characterize firms' efforts to distinguish between users and nonusers as a classic adverse selection problem and conclude that *overtesting* is likely in such an environment:

> There can be too much testing because testing is most attractive (least costly) to the workers who are at the lowest risk for drug abuse. Firms then have incentives to institute drug-testing programs in order to reduce the number of drug abusers they employ. This creates a negative externality for non-testing firms, because it reduces the quality of their applicant pool. As a result, the private value to workers of sending the signal that they are drug-free (by their willingness to work in settings with drug testing) generally exceeds the social value of the job sorting efficiencies that testing can bring [McGuire and Ruhm 1993: 21].

Hoyt (1995) presents a more general set of models in which workers not only choose their places of employment, but also choose levels of drug consumption in response to testing decisions by firms. Her empirical findings suggest that testing is an effective deterrent to drug consumption and that drug use and productivity are negatively correlated (ibid.: 231–33).

The model that I present in this paper differs from those just discussed in a number of important ways. First, I examine testing in its best possible light by assuming that it is not only perfectly reliable but also perfectly efficacious. The criticisms I offer of testing would merely be reinforced were the results from the first set of studies introduced. Second, my subjects are students making decisions about extracurricular activities rather than workers making employment decisions. Finally, my focus is on the policy objective of reducing *overall* drug use, whereas the more recent studies have been primarily concerned with the efficiencies arising from better sorting workers or from reducing drug use among one's employees. School officials are presumably concerned with more than just the "productivity" of

their athletic teams or the frequency of drug use among their student athletes alone.

Random, Suspicionless Drug Testing of High School Athletes: The Formal Model

The model that I present below is a "compensating behavior" model, in which individual responses to a government regulation diminish or even reverse the regulation's intended effect. Peltzman (1975) wrote the seminal piece in this literature, which showed that the presence of seat belts in automobiles caused drivers to drive more recklessly, thereby increasing the risk of injury to pedestrians and partially wiping out the safety gains achieved by seat belts. Subsequent studies have largely confirmed Peltzman's surprising result.[4] A host of papers in the past two decades has found evidence of compensating behavior in response to a number of other government safety regulations.[5] Among the most disturbing is Viscusi (1984), who finds evidence that the mandated introduction of child-resistant safety caps may have *increased* the incidence of analgesic poisonings.

A very recent compensating-behavior paper whose argument almost perfectly parallels my own is Hahn (1996). Hahn finds that the federal government's mandated security enhancements at airports following the TWA Flight 800 crash in July of 1996 will most likely *increase* fatalities. The delays and increased costs associated with these additional security precautions will lead marginal airline passengers to drive, which is a far riskier form of transportation than flying. Hahn predicts that the safety gains to inframarginal airline passengers (those who continue to fly and who are now better protected against terrorist acts, which are extremely infrequent in the United States) will be more than offset by the safety losses of the marginal airline passengers who now choose to drive rather than fly.

The Model's Assumptions

In order for compensating behavior to be an issue in the decision to drug test high-school athletes, several assumptions must hold. First, not only must nonathlete drug usage exceed athlete drug usage, but ex-athletes must also conform to the drug usage patterns of their nonathlete peers. The research that has been done in this area by sports physicians supports both of these propositions. As Table 1

[4]For example, see Crandall and Graham (1984), Blomquist (1988), Asch et al. (1991), and Singh and Thayer (1992).

[5]For an overview, see Chapter 13 (entitled "Consumer Behavior and the Safety Effects of Consumer Product Safety Regulation") of Viscusi (1992).

shows, strong evidence exists that nonathlete drug usage exceeds that of athletes. Moreover, sports physicians seem to believe that these differences are the result of the strict regimen required for athletic excellence. As Anderson et al. (1991: 102) point out in their article on drug consumption among college athletes, "the considerable physical and mental demands of high-level athletic competition may be incompatible with indiscriminate alcohol and drug use."[6] Ex-athletes, who are by definition no longer subject to these demands, are therefore likely to revert to the drug-use levels of nonathletes.

Second, the rate of athletic participation must not be completely insensitive to the costs of participation. Were the demand for athletic participation among students perfectly price inelastic, no compensating behavior would be possible. Complete insensitivity to cost is highly unlikely, however—a fact of which districts considering the implementation of drug-testing programs are keenly aware. Dorhmann (1996), for example, reports that many school districts hesitate to drug test athletes because "implementing a mandatory program could decrease student participation."

The combination of these two assumptions—that increasing the cost of being an athlete by imposing drug testing will reduce athletic participation and that ex-athletes will revert to the higher drug use levels of their nonathlete peers—guarantees some degree of compensating behavior. Whether such behavior will merely dampen the reduction in drug use or instead generate an increase will depend on a number of factors to be considered below.

A First Look at the Problem

Suppose that there are n students enrolled at a particular high school, of whom n_a choose to be athletes and $n - n_a$ choose to be nonathletes. Moreover, suppose that this distribution of students is an equilibrium one: each student is choosing an alternative that maximizes his or her utility, given the choices of other students. Let d_a and d_{na} be the drug consumption levels of a typical athlete and nonathlete, respectively, before the introduction of testing. On the basis of the evidence in Table 1, assume that $d_a < d_{na}$—that is, athletes consume fewer drugs, on average, than nonathletes prior to the introduction

[6]Given the relative paucity of data on the drug habits of high school athletes, I will assume throughout the paper that the gap in drug consumption rates between athletes and nonathletes is roughly the same in high school as it is in college. High school athletes are generally under less pressure to perform than college athletes, however, so the gap may very well be narrower for the former group than the latter. The usage gap evident in Table 1 should therefore be regarded as the upper bound for high school students.

of drug testing. Total drug consumption in the student body will therefore be:

$$(2) \qquad (n - n_a)d_{na} + n_a d_a = nd_{na} - (d_{na} - d_a)n_a.$$

Now suppose that the school implements a random drug-testing program for student athletes. I will put drug testing in the best possible light by assuming that it is not only perfectly reliable but also perfectly efficacious: that is, testing not only generates no false positives or negatives but also *drives drug use among athletes to zero*. Of course, such testing imposes a cost upon student athletes, who are now subject to unpredictable privacy invasions[7] and who are no longer able to consume recreational drugs, even in small quantities. Given the higher cost of athletic participation, some marginal athletes will "quit the team" and revert to the drug consumption patterns of their nonathlete peers. Let n_a' be the new equilibrium number of athletes. Total drug consumption in the student body will now be:

$$(3) \qquad (n - n_a')d_{na} = nd_{na} - n_a' d_{na}.$$

Thus, the introduction of drug testing will *increase* total drug consumption in the student body if and only if:

$$(4) \qquad nd_{na} - n_a' d_{na} > nd_{na} - n_a(d_{na} - d_a) \Rightarrow \frac{d_a}{d_{na}} < 1 - \frac{n_a'}{n_a}.$$

Equation (4) says that in order for testing to increase overall drug use, athlete drug use (before testing is introduced) as a percentage of nonathlete drug use must be less than the percentage reduction

[7]Justice Antonin Scalia, who wrote the majority opinion in *Vernonia School District v. Acton*, noted in his opinion that "legitimate privacy expectations are even less with regard to school athletes. School sports are not for the bashful" (*New York Times* 1995: B6). Shutler (1996: 1276) describes Vernonia High School's procedure for obtaining urine samples:

> The student-enters an empty locker room accompanied by an adult testing monitor of the same sex. With male students, each boy selected produces his sample at a urinal, remaining fully clothed and with his back to the monitor, who remains standing twelve to fifteen feet behind the student. Under the Policy as written, the monitor may watch the student while he produces the sample, although at no time are the student's genitals observed by the monitor. The procedure for girls differs in that the student produces the sample in an enclosed bathroom stall, so that the monitor does not observe the sample production but listens for normal sounds of urination. After producing the sample, the student gives it to the monitor who checks it for temperature and signs of tampering and then seals the sample, instructing the student to initial the seal.

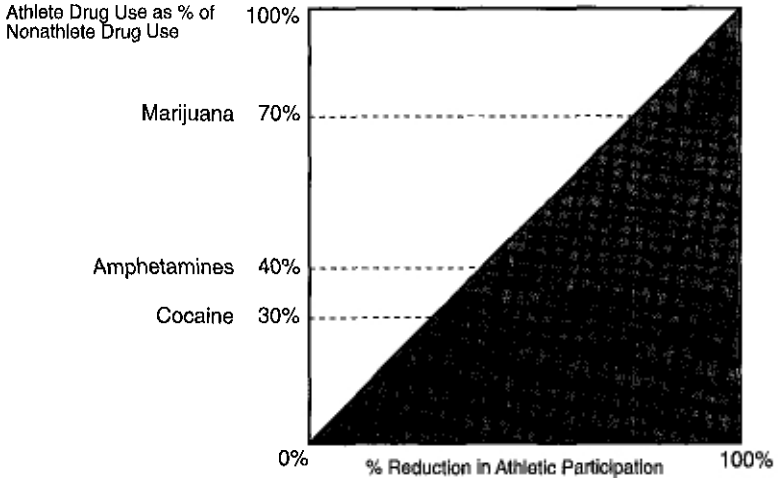
Although such a procedure may not violate an athlete's "legitimate privacy expectations," most athletes will view it as a cost of athletic participation, and some will surely cease to participate in order to avoid it.

in athletic participation. For example, suppose that athletic participation is cut in half after testing is introduced—a 50 percent reduction. In that case, overall drug use will increase if athlete drug use was less than 50 percent of nonathlete drug use prior to the introduction of testing. If it was exactly 50 percent, there will be no change in overall use: half of the athletes will stay and stop using drugs (recall that drug testing is perfectly efficacious); the other half will quit and double their drug use (emulating their nonathlete peers).

Figure 1 provides a graphical interpretation of Equation (4). The shaded area represents all combinations that result in an increase in overall drug use. One way to determine whether such combinations are likely to occur is to generate estimates of athlete drug use as a percentage of nonathlete drug use from data in Table 1. The ratio of use rates among athletes and nonathletes may serve as a rough approximation to the ratio of use levels if we assume that all users, athlete and nonathlete alike, consume equal quantities.[8] For reasons previously mentioned, however, such estimates will clearly be upper bounds: the strict regimen required of athletes will not only lead to lower use rates among athletes, but will also lead to lower levels of

FIGURE 1

DRUG USE AND ATHLETIC PARTICIPATION



[8]Specifically, the average drug use level in a group is equal to the average drug use level *among users* times the percentage of users in the group. If the average drug use level *among users* is the same across groups, then the ratio of average use levels across groups will be equal to the ratio of the percentage of users across groups.

TABLE 2

RATIOS OF ATHLETE USE RATES TO NONATHLETE USE RATES (PERCENT)

Drugs	Males	Females
Alcohol	96.8	96.7
Amphetamines	42.9	42.9
Cocaine/Crack	31.6	28.6
Marijuana/Hash	70.7	73.5

SOURCE: Table 1.

consumption among those who do use drugs. Table 2 calculates these ratios of use rates.

The approximate percentages for amphetamines, cocaine, and marijuana are plotted in Figure 1. Some of these percentages are surprisingly low, despite the fact that they are upper bounds. For example, the level of cocaine use among female athletes as a percentage of the level of use among nonathletes is only 28.6 percent. This figure implies that a reduction in athletic participation among women of greater than 28.6 percent would generate an increase in overall cocaine consumption.

One question that naturally arises is whether drops in participation of this magnitude are likely to occur. I will discuss this issue in more detail below, but one important point to keep in mind is that *marginal* athletes are driving the reductions in participation. A school's star quarterback will be unlikely to quit the team over drug testing, but the same cannot be said for second- and third-stringers on the football team. Substantial drops in participation are especially likely in those sports that are more individualistic and/or less prestigious than football (e.g., golf, cross-country, track, wrestling, volleyball).

The Determination of Equilibrium Participation Levels

In order to identify the factors that influence equilibrium participation levels, I will make the model described above considerably more explicit. As before, let d_a and d_{na} be the per-capita drug consumption levels of athletes (pre-testing) and nonathletes, respectively, and let A and NA be the gross utility payoffs associated with these levels of consumption. On the basis of the data in Table 1, I will again assume that $d_a < d_{na}$ and that, moreover, $A < NA$: the low consumption level of athletes affords less utility than the high consumption level of nonathletes.

Let $P(x)$ be the utility payoff of athletic participation for student x, where students are ranked in descending order according to the strength of their desire for athletic participation. This latter assumption implies that $P' < 0$. One can think of $P(x)$ as an inverse demand curve for athletic participation—as one moves down the inverse demand curve, one encounters students with lower and lower valuations for athletic participation. With this device, I am able to introduce heterogeneity of preferences in a particularly simple way.

An equilibrium will be achieved when each student is choosing an alternative that maximizes his or her utility, given the choices of other students. To find the equilibrium number of athletes, one must merely determine the rank-number of the marginal athlete, for whom the benefit of participation just equals the cost. Formally,

$$P(n_a) + A = NA, \tag{5}$$

where n_a is both the rank-number of the marginal athlete and the (pre-testing) equilibrium number of athletes discussed previously.

Suppose now that random, suspicionless drug testing of athletes is introduced. Testing imposes two distinct costs on athletes: first, it imposes a "privacy invasion" cost of C; second, it imposes a "sobriety" cost of A—as above, I assume that drug testing is perfectly efficacious and therefore drives drug consumption among athletes (and the gross utility payoff associated with it) to zero. These costs lead marginal athletes to "quit the team." Equilibrium is reestablished when all athletes for whom the now higher cost of participation outweighs the benefit have quit. To find the new equilibrium number of athletes, one must again determine the rank-number of the marginal athlete, for whom the benefit of participation just equals the cost. Formally,

$$P(n_a') - C = NA, \tag{6}$$

where n_a' is both the rank-number of the new marginal athlete and the (post-testing) equilibrium number of athletes discussed previously.

I assume that $P(x)$ is an affine function of the form $P(x) = P^* - kx$, where P^* is the highest valuation for athletic participation in the student body and k determines the rate at which these valuations decline. Given this assumption, I can obtain a closed-form solution for n_a in Equation (5) and n_a' in Equation (6). Plugging these solutions into Equation (4), I obtain:

$$\frac{d_a}{d_{na}} < \frac{A + C}{P^* + A - NA}. \tag{7}$$

Thus, overall drug use in the student body will *increase* upon the introduction of testing if Equation (7) holds.

Comparative Statics

Given that virtually all of the terms in Equation (7) are unknowns, I will write in a probabilistic sense when discussing comparative statics. The likelihood that the introduction of testing will increase overall drug use increases as:

1. $A\uparrow$, $NA\uparrow$: the higher the payoff to drug use among athletes[9] and nonathletes, the more likely is an increase in drug use. Schools with thriving "drug cultures" that encourage experimentation with narcotics are especially likely to experience an increase in overall usage.
2. $d_a/d_{na}\downarrow$: the lower the ratio of athlete drug use to nonathlete drug use prior to testing, the more likely is an increase in drug use. When this ratio is low, the introduction of testing reduces drug use very little among inframarginal athletes (they were using very little to begin with) but increases it substantially among those marginal athletes who quit the team and adopt the drug consumption patterns of their nonathlete peers. The risk is especially high when drugs like amphetamines and cocaine are popular, as Table 2 and Figure 1 demonstrate.
3. $P^*\downarrow$: the lower the highest student valuation for athletics, the more likely is an increase in drug use. One factor that will strongly influence student valuations (including the highest valuation) for athletics is the prestige attached to participation. As noted earlier, low-prestige sports such as track, cross-country, and golf are more likely to see reductions in participation than high-prestige sports such as football and basketball. Schools at which athletic participation in general is not prestigious are especially vulnerable to increases in drug use after the institution of testing.[10]
4. $C\uparrow$: the higher the "privacy invasion" cost of testing, the more likely is an increase in drug use. School officials should clearly do everything within their power to reduce the degradation and embarrassment associated with drug testing if they hope to

[9]By using the Quotient Rule to evaluate the derivative of the right hand of Equation (7) with respect to A, one can determine that an increase in A makes an overall increase in drug use more likely if and only if $P^* - C > NA$. But this condition must hold if *any* students are to choose athletics.

[10]Interestingly, athletics are highly prestigious in Vernonia, Oregon (of *Vernonia v. Acton*). Shutler (1996: 1273) reports that "because of the town's small size and isolated location, school athletics play a prominent role, and the community greatly admires student athletes. Between sixty and sixty-five percent of high school students and approximately seventy-five percent of elementary students participate in one of the District's seven extracurricular sports activities." Vernonia would therefore be less likely, *ceteris paribus*, to see drug use increase after the introduction of testing.

minimize the likelihood of an exodus from the athletic program and a subsequent increase in overall drug use. Technological advances that make possible less-invasive testing techniques—for example, the ability to test hair samples rather than urine samples (Reuter 1988: 556)—will clearly make this task much easier.

Conclusion

Few people would question the desirability of minimizing the use of drugs among minors. The use of random, suspicionless drug testing of school athletes as a means to achieve this end is more open to question, however. Not only does this policy invade the privacy of a group of students who are relatively unlikely to use drugs, but it also discourages athletic participation and may actually lead to an *increase* in overall drug use. Even in those cases where the adoption of such testing leads to a reduction in overall drug use, compensating behavior by student athletes guarantees that the reduction in use will be smaller, perhaps much smaller, than expected.

Until now, I have assumed that the sole objective of school administrators is to minimize drug use. However, school administrators may have preferences regarding not only the *level* of overall use, but also its *distribution*. The policy of drug testing high school athletes unambiguously increases the variance of drug use in the student population: use falls among the (inframarginal) athletes who continue to participate in sports but increases among the (marginal) athletes who "quit the team" and revert to the higher use levels of their nonathlete peers. Holding overall use fixed, redistributing drug use from low-level users to high-level users may be considered undesirable, especially if the negative health effects are very small for low-level use but extremely large for high-level use.[11] If so, then the policy of drug testing student athletes looks even less attractive that it did before.

The results of this predominantly theoretical investigation suggest the need for careful empirical studies. The currently slow pace of adoption among schools gives researchers time to begin case-by-case examinations of the effect of drug testing on the level and distribution of drug use among students. School administrators, who for political reasons may be pushed into adopting drug testing programs before their usefulness is verified, should be extremely cautious during the

[11]More precisely, if the negative health effects increase *at an increasing rate* with drug use (i.e., the dose-response function is convex), then a mean-preserving increase in the variance of drug use will increase negative health effects.

initial phase of implementation. If major reductions in athletic participation are observed, a concerted effort should be made to determine the effect of this change on overall drug use and to consider alternative approaches if necessary.[12] The possibility of increased drug use is very real and should be kept constantly in mind when such programs are proposed or adopted.

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