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THE BODY AND THE LAW: HOW PHYSIOLOGICAL AND LEGAL OBSTACLES COMBINE TO CREATE BARRIERS TO ACCURATE DRUG TESTING

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I. INTRODUCTION

Doping in sports goes back thousands of years to the ancient Olympic Games in Greece where athletes tried to improve their performance through artificial means.[1] However, as the effects and long-term consequences of doping have been revealed, and issues surrounding fairness and ethics have come to the forefront, more organizations have sought to detect and control doping by athletes.

The attempts to detect doping have come from the scientific community in the form of detection tests. The legal community attempts to control doping in the form of laws banning certain substances. However, there are others in the scientific community continuously searching for new methods of doping and new, non-detectable drugs, while the legal community is limited by personal rights regarding privacy and limits on what tests are legally valid, which prevent the laws from always keeping up with the science. The legal community is continually trying to keep up with this constant clash between those that attempt to develop new means of doping and those that attempt to detect it. This article will examine how some physiological obstacles to accurate drug testing are compounded by the legal obstacles involving whether such drug testing is even admissible in a court of law.

This article is divided into two main sections. Section II discusses the physiological barriers to accurate drug testing. The topics covered include the

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1. Kenneth D. Fitch, *Androgenic-Anabolic Steroids and the Olympic Games*, 10 ASIAN J. ANDROL. 384, 384 (2008).

types of tests used to detect doping and some specific types of ergogenic aids and the problems that arise when trying to detect them. Section III examines the legal obstacles that exist, including constitutional concerns and to whom the Constitution applies, as well as issues surrounding the admissibility of scientific evidence in court. Section IV concludes with a brief discussion of the consequences of inaccurate drug testing.

II. PHYSIOLOGICAL BARRIERS

Modern drug testing began in the late 1950s, with the death of elite cyclists, occuring in the 1960s from amphetamine use.[2] "The first formal testing for non-steroidal drugs occurred at the 1972 . . . Olympics Games" in Munich, Germany.[3] With the addition of radioimmunoassay (RIA) and gas chromatography-mass spectrometry (GC-MS) methods, anabolic steroids were tested for in the 1976 Montreal Olympic Games.[4] In 1983, there was a test developed for detecting synthetic testosterone (T) by measuring urine T levels and its chemical variation epitestosterone (E).[5] Although there are a variety of tests used to detect doping, there are three tests for urine samples and two for blood samples that are the primary tests discussed in this article.

A. Types of Drug Tests

The classes of drugs include, but are not limited to, stimulants, narcotics, anabolic-androgenic steroids, beta-agonists, beta blockers, diuretics, peptide hormones, and masking agents.[6] Due to the sheer number of ergogenic aids available, this paper is limited to androgens, such as testosterone; beta$_2$-agonists (β_2-agonists), like clenbuterol; and peptide hormones, such as human growth hormone (hGH) and erythropoietin (EPO).

1. Gas Chromatography-Mass Spectrometry

All substances used in doping have unique "fingerprints," a specific breakdown of the molecules of the substance into ionic pieces.[7] Gas Chromatography-Mass Spectrometry (GC-MS) isolates this fingerprint by

2. Craig R. Kammerer, *What is Doping and How is it Detected, in* DOPING IN ELITE SPORT: THE POLITICS OF DRUGS IN THE OLYMPIC MOVEMENT 3, 4 (Wayne Wilson & Edward Derse eds., 2001).

3. *Id.*

4. *Id.*

5. *Id.*

6. *Id.* at 6.

7. *Id.* at 9.

separating the suspected drugs from the other substances in the urine sample.[8] The suspected drugs are "then bombarded by small particles, causing disintegration of the drug molecule into smaller fragments."[9] Computer analysis determines what drug the substance is based on its fragmentation pattern.[10] When performed properly, GC-MS has a near one hundred percent accuracy and can test samples at very low concentrations.[11] The limitation, of course, is that if there is no reference sample for a substance, it cannot be tested for.

2. Liquid Chromatography-Mass Spectrometry

Liquid Chromatography-Mass Spectrometry (LC-MS) is similar to GC-MS.[12] The only difference is that the sample is processed in a liquid state, instead of a gaseous state.[13] The advantages of LC-MS over GC-MS is that LC-MS can be performed at room temperature, unlike GC-MS, which requires that the sample be heated until it turns into a gas.[14] LC-MS can also be used to detect some substances GC-MS cannot, such as "unstable, polar, and large molecular weight natural hormones ([h]GH, EPO, etc.)."[15]

3. Isotope Ratio Mass Spectrometry

The newest of the three tests discussed is Isotope Ratio Mass Spectrometry (IRMS). This test is more specific in its purpose, being used primarily to detect whether T levels are due to endogenous (within the body) production or due to exogenous (outside the body) administration.[16] This test looks for ^{13}C, a carbon isotope that is affected by the amount of carbon ingested.[17] Since most synthetic T is made from soybeans, and soybeans have a lower ^{13}C content than natural T, those with an abnormally low ^{13}C ratio are considered to have used synthetic T.[18]

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8. David J. Greenblatt, *Urine Drug Testing: What Does it Test?*, 23 NEW ENG. L. REV. 651, 655 (1989).

9. *Id.*

10. *Id.*

11. *Id.*

12. Kammerer, *supra* note 2, at 9.

13. *Id.*

14. *Id.*

15. *Id.*

16. *Id.* at 10; Michael R. Graham et al., *Anabolic Steroid Use: Patterns of Use and Detection of Doping*, 38 SPORTS MED. 505, 519 (2008).

17. Graham et al., *supra* note 16, at 519.

18. *Id.*

The disadvantage of IRMS is that the instruments are very expensive, over $100,000 each, and it cannot be used to screen for other routine drugs, such as steroids.[19] IRMS also has difficulty distinguishing gender and metabolism differences.[20]

4. The Isoform Approach and the hGH-Responsive Proteins Method

There are two current methods for detecting hGH doping. Both are blood tests, not urine tests. They are discussed in more detail in II.D.1., the section on human growth hormone.

B. Androgens

Over the past five decades, androgenic-anabolic steroids (AAS) have been one of the drugs most abused by athletes to increase sports performance. AAS are derivatives of testosterone that produce masculinizing (i.e. androgenic) and tissue-building (anabolic) effects.[21] Although there is speculation that AAS were used as early as the Olympic Games in the 1950s, there is evidence that they were used at the Olympic Games in the 1960s, with more prevalence at the 1972 Munich Olympics.[22] With the introduction of RIA in 1974, the International Olympic Committee (IOC) "prohibited AAS with the first positives at the 1976 Montreal Games."[23] The 1984 Olympic Games was the first to use GC-MS to identify AAS.[24] Positives were found at the 1984 Olympics, and again in 1988 in Seoul, South Korea, where the 100-meter sprint gold medal winner, Ben Johnson, tested positive for AAS use.[25] There are many different types of AAS, but one particular trouble area is the detection of natural androgens: testosterone (T), epitestosterone (E), and dihydrotestosterone (DHT).

1. Testosterone

The use of natural androgens is one way athletes have been able to avoid detection.[26] Detecting prohibited use of natural androgens like T is difficult

19. Kammerer, *supra* note 2, at 10-11.

20. *Id.* at 11.

21. STAN REENTS, SPORT AND EXERCISE PHARMACOLOGY 162 (2000).

22. Fitch, *supra* note 1, at 385.

23. *Id.* at 386.

24. *Id.* at 387.

25. SHAUN ASSAEL, STEROID NATION xvi (ESPN Books 2007).

26. David J. Handelsman & Alison Heather, *Androgen Abuse in Sports*, 10 ASIAN J. ANDROL. 403, 405 (2008).

because it "requires distinguishing between endogenous and exogenous forms of the same steroid" molecule.[27] The testosterone/epitestosterone ratio (T/E ratio) test is the current method used to detect exogenous T administration.[28] T and E exist in approximately equal amounts in men and women, with the absolute quantities in women five-fold lower than men.[29] The original T/E ratio of 6:1 was evidence of using T, but many sport organizations had reservations about implicating positive results because of the small number of cases of T/E ratios greater than 6:1 that were not the result of exogenous T abuse.[30] The recent lowering of the T/E ratio to 4:1 has led to more false-positive tests due to several factors including individual, gender, and ethnic differences.[31]

a. Individual Differences

There have been cases of individual athletes whose T/E ratio naturally exceeds 6:1.[32] The most likely cause of abnormal T/E ratios is due to low endogenous E production.[33] During the 1984 Olympic Games, a Japanese volleyball player had a T/E ratio of 10:1, but was not suspended, and investigations later validated that the athlete had a naturally elevated T/E ratio.[34] Likewise, at the 1988 Seoul Olympics, a U.S. basketball player had a T/E ratio of 7:1, but was exonerated because previous tests had demonstrated a T/E ratio between 5.4:1 and 5.8:1.[35] There is no set percentage by which one test must differ from another to be deemed suspicious; however, the ten percent variation for the basketball player was determined to be too low to be considered a positive test.[36]

b. Ethnic Differences

Besides individual genetic differences in T and E levels, there is also growing evidence that different ethnicities experience different T/E ratios. Many East Asian athletes have a significantly lower T/E ratio than

27. *Id.*
28. *Id.*
29. Kammerer, *supra* note 2, at 11.
30. *Id.* at 12.
31. Handelsman & Heather, *supra* note 26, at 405.
32. *Id.*
33. *Id.*
34. Fitch, *supra* note 1, at 387.
35. *Id.*
36. *Id.*

Caucasians.[37] Recent studies have identified a genetic deletion leading to a functional mutation of a major hepatic androgenic enzyme that has a significant influence on T/E ratios.[38] Compared with Caucasians,[39] the genetic deletion of the enzyme occurs seven times more frequently in Asians and five times less frequently in African Americans.[40] As a result, many East Asians have normal T/E ratios below 1:1.[41] This means that they could use exogenous T to increase their T levels by six to ten times and still register a negative T/E ratio test result.[42]

c. Gender Differences

It is more difficult to prove T doping by female athletes, because T levels are much lower in females, and because both T and E levels can fluctuate.[43] This may be due to the monthly hormonal cycle-dependent fluctuations in the T/E ratio or the use of oral contraceptives.[44] It is recommended that the T/E ratio test be disregarded, especially in female athletes "because of the current lack of scientific knowledge of natural variance limits of female androgen production."[45]

Alcohol use can also increase the T/E ratio for both genders, but this increase is greater for women.[46] A recent example of a high T/E ratio being attributed to alcohol consumption is Floyd Landis. His T/E ratio after the 2006 Tour de France was 11:1,[47] which Landis claimed was due to alcohol use.[48]

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37. *Id.*

38. Jenny Jakobsson et al., *Large Differences in Testosterone Excretion in Korean and Swedish Men are Strongly Associated with a UDP-Glucuronosyl Transferase 2B17 Polymorphism*, J. CLIN. ENDOCRINOL & METAB. 687, 687-88 (2006).

39. *Id.* at 692.

40. Handelsman & Heather, *supra* note 26, at 405.

41. Fitch, *supra* note 1, at 387.

42. *Id.*

43. Kammerer, *supra* note 2, at 13.

44. *Id.* at 11.

45. David L. Black, *Doping Control Testing Policies and Procedures: A Critique*, *in* DOPING IN ELITE SPORT: THE POLITICS OF DRUGS IN THE OLYMPIC MOVEMENT 29, 40 (Wayne Wilson & Edward Derse eds., 2001).

46. Kammerer, *supra* note 2, at 13.

47. ASSAEL, *supra* note 25, at 270.

48. Juliet Macur & Gina Kolata, *Landis is on Message, but Points are Disputed*, N.Y. TIMES, July 29, 2006, *available at* http://www.nytimes.com/2006/07/29/sports/othersports/29testing.html?pagewanted=2&sq=landis%20and%20alcohol&st=nyt&scp=1.

d. Administration of Epitestosterone with Testosterone

The use of the T/E ratio test has led some athletes to mask the use of androgens by co-administering E with T to reduce the T/E ratio to acceptable levels.[49] In fact, it has been suggested that during the 1980s the East Germans administered E to their athletes to reduce their T/E ratio to less than 6:1.[50] E is now banned as a masking agent, and in 2004, the World Anti-Doping Agency (WADA) stated that corrected urinary concentrations of E greater than two ng/ml are indicative of E administration.[51]

e. Low Dose/Route of Administration

Another more simple, yet effective, way to abuse androgens without detection is simply to use low to moderate amounts of T that do not raise the T/E ratio significantly. This is one of the main reasons WADA, in 2005, lowered the T/E ratio from 6:1 to 4:1.[52] Due to individual, gender, and ethnic differences, some athletes could theoretically take moderate to large doses of T and still remain within acceptable limits. As mentioned previously, East Asians (or others with genetic anomalies) with normal T/E ratios below 1:1 could increase their ratio six- to ten-fold and still may not exceed the T/E ratio cut-off.[53]

Another method employed by athletes is to dose with low amounts of T using skin patches and gels.[54] The patches are designed to release T in varying levels over a twenty-four hour period.[55] The low dose per patch, along with time-release properties, yields more stable blood levels, making it less likely for urinary testing to exceed a 6:1 T/E ratio.[56] With dose modification combined with sustained-release application, it is possible for the athlete to use T during training and even up to the competition with a very low risk of testing positive.[57]

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49. Handelsman & Heather, *supra* note 26, at 405.

50. Fitch, *supra* note 1, at 387.

51. World Anti-Doping Agency, *Minimum Required Performance Limits for Detection of Prohibited Substances*, http://www.wada-ama.org/rtecontent/document/perf_limits_2.pdf (last visited Aug. 7, 2008).

52. Fitch, *supra* note 1, at 387.

53. *Id.*

54. Krammerer, *supra* note 2, at 13.

55. WILLIAM LLEWELLYN, ANABOLICS 134 (2007).

56. Kammerer, *supra* note 2, at 13.

57. *Id.* at 13-14.

2. Dihydrotestosterone

Dihydrotestosterone (DHT) is the most potent androgen in the human body, measured to be approximately three to four times stronger than T.[58] T is converted to DHT in the body via interaction with the 5-alpha reductase enzyme.[59] DHT is present in large amounts in tissues such as the prostate, skin, scalp, liver, and various regions of the central nervous system (CNS).

It is the role that DHT plays in the CNS and muscular system, collectively referred to as the neuromuscular system, which makes this drug attractive to athletes. One study demonstrated increased androgen receptor proliferation in neural cells in both T and DHT, with DHT sustaining the increase three times as long.[60] What this means in real world athletic competition is that an increase in neuromuscular coordination could increase strength, power, and reflex time.

In a classic study by Ariel and Saville,[61] there was a demonstrable increase in knee jerk reflex reaction time in athletes using AAS.[62] "These data suggest that anabolic steroids might be beneficial for athletes such as boxers, hockey goalies, and baseball hitters."[63] These results suggest that potent androgens like DHT could benefit athletes whose sport demands quick reaction time and short bursts of power and quickness.

DHT has been detected in athletes, including a number of female Chinese swimmers at the World Championships in 1994.[64] Positives were determined by comparison analysis of DHT and other endogenous steroids.[65] DHT can, therefore, be tested for along with a co-secreted precursor steroid, such as E. The increase in the DHT/E ratio in urine can be an indicator of exogenous administration of DHT.[66] However, as with the T/E ratio test, the individual, ethnic, gender, and dose-response relationships that may make it difficult to detect doping in some athletes.

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58. LLEWELLYN, *supra* note 55, at 128.

59. *Id.*

60. *Id.*

61. Gideon Ariel & William Saville, *Effect of Anabolic Steroids on Reflex Components*, 32 J. APPL. PHYSIOL. 795, 797 (1972).

62. *Id.* at 797.

63. REENTS, *supra* note 21, at 174.

64. Kammerer, *supra* note 2, at 13.

65. *Id.*

66. Handelsman & Heather, *supra* note 26, at 405.

3. Designer Androgens

Designer androgens are "synthetic androgens purposely developed to evade detection by the conventional urine MS-based doping tests."[67] Much of the original research on designer androgens date back to the original AAS developmental research in the 1960s and 1970s, when pharmaceutical companies were experimenting with chemical variations of AAS.[68] When the patent rights expired years later, some of these unique, chemically obscure AAS remerged.[69]

The AAS furazabol, from Japan, is a DHT derivative that was used by athletes for several years before it was identified and tested for.[70] In 2002, Don Catlin, "America's Leading Steroid Hunter,"[71] detected an old designer androgen called norbolethone in the urine of a female cyclist.[72] In 2003, tetrahydrogesterinone (THG), a completely unknown androgen, was sent to Catlin for analysis.[73] THG is the notorious designer androgen that arose from the Bay Area Laboratory Cooperative (BALCO) scandal involving track star Marion Jones.[74] In 2005, a third designer androgen, desoxymethyltestosterone (DMT), was discovered.[75] Subsequently, other designer androgens arose from the neutriceutical food supplements, which advertised "prohormones" or androgen precursors.[76]

The biggest problem associated with androgen doping is the sheer diversity and almost infinite structural modifications that can be made, which makes detection of these unknown androgens difficult. Detection methods, such as GC-MS and LC-MS, use reference samples of the drug to compare with the metabolites found in the urine.[77] Since the designer androgen is unknown and there are no reference samples, athletes have the ability to use designer androgens without detection.

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67. *Id.*

68. *Id.*

69. *Id.* at 406.

70. LLEWELLYN, *supra* note 55, at 275.

71. ASSAEL, *supra* note 25, at xiv; Don Catlin was the Director of the UCLA Olympic Analysis Laboratory from 1983-2007.

72. Fitch, *supra* note 1, at 388.

73. *Id.*

74. ASSAEL, *supra* note 25, at 254.

75. Handelsman & Heather, *supra* note 26, at 406.

76. *Id.*

77. Kammerer, *supra* note 2, at 9.

4. DHEA and Prohormones

Starting in 1994, legislation allowed the sale of steroid precursors (i.e. prohormones) as neutricuetical food supplements.[78] Soon thereafter, the supplement companies started flooding the market with androgen precursors or prohormones, such as 1-testosterone, dehydroepiandrosterone (DHEA), and androstenendione.[79] At the time, there were neither testing nor bans by most athletic associations on many of these new androgens.[80]

Androstenendione, or "andro" as it was popularized, was the prohormone that experienced a rapid growth in sales after Mark McGwire admitted using it during his record-breaking home run season.[81] It was later reported that "andro" acts similarly to AAS in the body and, in sufficient quantities, could increase serum T levels and increase muscle mass in eugonadal males.[82] Meeting all the requirements as an AAS, Congress amended the earlier ruling with new legislation that reclassified certain synthetic androgens as drugs rather than food supplements.[83]

DHEA is a weak androgen precursor that is converted in the peripheral tissues to T and estradoil and functions as a neurosteroid.[84] The IOC prohibits the use of DHEA.[85] The literature reveals that it is difficult to demonstrate DHEA as being an ergogenic aid because of research limitations including animal models, heterogeneity of dosing, formulations, and study populations in humans.[86] It is difficult to test for DHEA using IRMS, the method of choice. The complexity and genetic differences in metabolism may make it difficult to differentiate between dietary and pharmaceutical DHEA.[87] DHEA is detected with GC-MS by observing elevated DHEA hormone derivatives in urine.[88] However, detection is further complicated due to an incomplete understanding of DHEA metabolism and natural variations in individual

78. Handelsman & Heather, *supra* note 26, at 406.

79. *Id.*

80. *Id.*

81. Karen Choong et al., *The Physiological and Pharmacological Basis for the Ergogenic Effects of Androgens in Elite Sports*, 10 ASIAN J. ANDROL. 351, 357 (2008).

82. *Id.*

83. Handelsman & Heather, *supra* note 26, at 406.

84. Choong et al, *supra* note 81, at 358.

85. World Anti-Doping Code, *The 2008 Prohibited List: International Standard*, §S1(1)(b), Sept. 22, 2007, http://www.wada-ama.org/rtecontent/document/2008_List_En.pdf (last visited Aug. 6, 2008).

86. *Id.*

87. Kammerer, *supra* note 2, at 11.

88. A.T. Cawley et al., *Searching for New Markers of Endogenous Steroid Administration in Athletes: "Looking Outside the Metabolic Box"*, 143 FORENSIC SCI. INT'L 103, 104 (2004).

urinary excretions.[89]

5. Gonadotropins and Indirect Androgen Doping

Another way athletes have tried to circumvent the ban on androgen doping is to increase endogenous T indirectly with the use of gonadotropin drugs, such as leutinizing hormone (LH) and human chorionic gonadotropin (hCG).[90] These drugs indirectly stimulate T through LH-dependent Leydig cells.[91] hCG is actually produced in the placenta of the female body during the early months of pregnancy and is used as a marker for pregnancy tests.[92] Male athletes use hCG because it can stimulate endogenous T production without affecting the T/E ratio.[93] Male bodybuilders have used hCG for years to stimulate endogenous T production following a cycle of AAS.[94]

Male athletes with urine levels greater than specific values of hCG and LH are in violation of doping.[95] Both hCG and LH are detected in urine by using analysis of immunoassays of hormone specific antibodies.[96] Some of these methods have limitations, so now GC-MS and LC-MS are being combined through WADA sponsored research.[97]

In female athletes, it seems that hCG has negligible effects on T levels.[98] Testing for hCG in women may have other legal ramifications because it may expose an unrecognized pregnancy and, thus, be an invasion of privacy.[99]

6. Anti-estrogens and Aromatase inhibitors

Anti-estrogens and aromatase inhibitors (AI) are often used by athletes who self-administer AAS to decrease the side effects associated with increased estrogen levels caused by AAS use.[100] Tamoxifin citrate is a potent estrogen antagonist in breast tissue and is used by male athletes to prevent breast tissue

89. *Id.*

90. Handelsman & Heather, *supra* note 26, at 409.

91. *Id.*

92. LLEWELLYN, *supra* note 55, at 551.

93. Osquel Barroso et al., *Hormone Abuse in Sports: The Antidoping Perspective*, 10 ASIAN J. ANDROL. 391, 393 (2008).

94. LLEWELLYN, *supra* note 55, at 552.

95. Barroso et al., *supra* note 93, at 393.

96. *Id.*

97. *Id.* at 393-94.

98. *Id.* at 393.

99. *Id.*

100. LLEWELLYN, *supra* note 55, at 35.

formation (i.e. gynocomastia) while using AAS.[101] Tamoxifin citrate and other anti-estrogen drugs, such as clomiphene, can increase the production of follicle stimulating hormones (FSH) and LH in the male body.[102] Like the gonadotropin drugs, the higher release of LH can stimulate the Leydig cells to produce more T and, thus, increase athletic performance.

Anti-estrogens (e.g., tamoxifin citrate) are detected using LC-MS and GC-MS; while, WADA has sponsored methods such as Liquid Chromatography-tandem Mass Spectrometry (LC-MS/MS) and GC-MS to detect AIs such as anastrozole and letrozole.[103]

C. β_2-agonists

β_2-agonists are drugs that are clinically used in the treatment of asthma and exercise-induced bronchoconstriction (EIB).[104] One popular β_2-agonist used by athletes is albuterol, which is most commonly available as an inhaler.[105] Evidence suggests that the route of administration of β_2-agonists influences the degree of metabolic effects.[106] Clinical data indicates that albuterol, especially when administered via inhalation, provides no ergogenic effect.[107] This has not stopped endurance athletes from taking "hits" from their albuterol inhalers during triathlon competitions.[108]

An interesting aspect of some longer lasting oral β_2-agonists is their influence on the musculoskeletal system. Clenbuterol, a long-acting β_2-agonist, which is available for human use in Europe, has demonstrated anabolic effects in animal studies.[109] Clenbuterol is often used in livestock animals to increase muscle mass and decrease fat mass.[110] Human studies on clenbuterol are inconclusive because it is difficult to replicate the extremely large doses used in animal studies.[111] Nevertheless, athletes believe clenbuterol has muscle-building and fat-immobilizing effects.[112] Although its

101. *Id.* at 438.
102. *Id.*
103. Barroso et al., *supra* note 93, at 398.
104. REENTS, *supra* note 21, at 121.
105. *Id.* at 121-22.
106. *Id.* at 130.
107. *Id.* at 134.
108. *See id.*
109. LLEWELLYN, *supra* note 55, at 472.
110. REENTS, *supra* note 21, at 130.
111. *Id.*
112. *Id.*

anabolic effects are questionable, the IOC bans clenbuterol.[113]

Traditional screening and confirmation methods for clenbuterol doping in humans are based on GC-MS.[114] However, newer testing procedures, including improvements in LC-MS and LC-MS/MS, have been used because of greater sensitivity and reduced sample preparation time.[115] Confirmation of doping β_2-agonists, like clenbuterol, can be difficult because of the short duration of the drug in the body. Clenbuterol has a half-life of approximately thirty-four hours, making detection beyond several days, after discontinuing ingestion, difficult.[116] Since clenbuterol is used in small doses and can be used during training up to several days before competition, use of this drug is difficult to control.[117] There is also a possible risk of a false positive test after consuming meat from an animal that was administered clenbuterol.[118]

D. Peptide Hormones

Non-steroidal peptide hormones with potential performance enhancing properties are included on WADA's List of Prohibited Substances.[119] Banned substances and their releasing factors include human growth hormone (hGH), insulin-like growth factors (IGFs), insulins, erythropoietin (EPO), and gonadotrophins (LH, hCG).[120]

1. Human Growth Hormone & Insulin-Like Growth Factor 1

hGH is a protein hormone secreted from the anterior pituitary gland that is important in the growth and anabolism of all body systems.[121] Levels of hGH are particularly high in adolescence, when it promotes growth of muscles and decreases levels of subcutaneous fat stores.[122] Recombinant hGH (rhGH) is a potent anabolic hormone when used to treat hormone deficient individuals, but current research has demonstrated no statistically significant increases in

113. Kammerer, *supra* note 2, at 7.

114. Mario Thevis et al., *Liquid Chromatography/Electrospray Ionization Tandem Mass Spectrometric Screening and Confirmation Methods for β_2-agonists in Human or Equine Urine*, 38 J. MASS SPECTROMETRY 1197, 1197 (2003).

115. *Id.*

116. LLEWELLYN, *supra* note 55, at 60.

117. Kammerer, *supra* note 2, at 16.

118. *Id.* at 18.

119. World Anti-Doping Code, *supra* note 85, § S2.

120. Barroso et al., *supra* note 93, at 393. Due to gonadotrophins increasing T levels, they were discussed under Androgens.

121. REENTS, *supra* note 21, at 150.

122. LLEWELLYN, *supra* note 55, at 501.

muscle size or strength with administration.[123] Nevertheless, use of hGH is on the rise with reports of athletes spending up to $30,000 per year on hGH.[124]

In spite of its high cost, lack of proven effectiveness, and side effects, athletes continue to abuse hGH because it is the most difficult drug to detect using established drug testing procedures.[125] Developing a test for hGH is challenging because urine concentrations are very low, there are variable blood levels within the same individual throughout the day, and rhGH has the identical amino acid sequence as endogenous hGH.[126] hGH has a half-life of only fifteen to twenty minutes, and exogenous hGH administration dissipates rapidly from the blood and urine.[127] hGH plasma concentrations can increase up to ten-fold during exercise, therefore, increases in circulating hGH are not indicative of exogenous use.[128] Due to these disadvantages, blood testing is required to identify the abuse of hGH.[129] When hGH is secreted by the pituitary gland, it circulates as a number of slightly different peptides called isoforms.[130] One isoform, 22K GH, is the most abundant form of hGH and is used in a ratio with other pituitary isoforms of hGH.[131]

This "isoform approach" to testing hGH is very similar in nature to the T/E ratio test for androgens. One major limitation of this test is the short window (twenty-four to forty-eight hours post injection) of opportunity to detect hGH.[132] The isoform test can only detect 22K GH, and if cannot detect doping of pituitary-derived hGH, IGF-1, or hGH secretagogues.[133] Although the isoform method test was implemented by WADA during the 2004 Athens and 2006 Turino Olympic Games, there have been no irregular findings using this test.[134] This test may be useful for surprise random testing during out-of-competition testing.[135]

The other current approach of testing hGH doping is measuring hGH-responsive proteins that have a longer half-life and more stable concentration

123. Graham et al., *supra* note 16, at 521.

124. REENTS, *supra* note 21, at 151.

125. Graham et al., *supra* note 16, at 521.

126. Anne E. Nelson & Ken K. Ho, *A Robust Test for Growth Hormone Doping – Present Status and Future Prospects*, 10 ASIAN J. ANDROL. 416, 417 (2008).

127. *Id.*

128. *Id.*

129. Graham et al., *supra* note 16, at 521.

130. Nelson & Ho, *supra* note 126, at 417-18.

131. *Id.* at 418.

132. Patrick Arnold, *EPO Wannabes and the Doping Wars*, MUSCULAR DEV., July 2008, at 320.

133. Nelson & Ho, *supra* note 126, at 419.

134. *Id.*

135. *Id.*

levels than hGH.[136] For example, hGH stimulates IGF-1, which is most directly responsible for the anabolic actions of hGH.[137] Most of the IGF-1 in circulation is bound as a protein (IGFBP-3) that has a half-life of up to fifteen hours.[138] hGH can also stimulate collagen peptides, which have a half-life of ninety to five hundred hours, making these markers easier to detect.[139]

One of the disadvantages of the hGH-responsive markers test is that there may be a wide variation in hGH responsive proteins such as IGF-1.[140] This test is claiming an eighty-six percent chance of success in males and a sixty percent chance in females using super-physiologic doses of hGH.[141] Despite these drawbacks, the hGH markers approach could be improved by taking age into account, using a combination of markers, and tracking within-subject variability over time. There is also the advantage of detecting other agents such as pituitary-derived hGH, IGF-1, or hGH secretagogues.[142]

There are several new approaches being developed to detect hGH doping. One novel approach is the study of gene expression in blood leucocytes.[143] There is strong evidence that hGH regulates the immune system, and leucocytes respond directly to hGH and IGF-1.[144] Another method, proteomics, is being applied to blood serum to investigate protein markers or diagnostic profiles from subjects treated with hGH.[145] Finally, new immunoassay testing methods, along with older testing methods, such as mass spectrometry tests, are being used to detect hGH doping.[146]

Most of the growth effects, including increase in total body protein and muscle synthesis with hGH, are mediated by IGF-1.[147] hGH stimulates the liver to produce IGF-1, which circulates and acts on body tissues.[148] Experiments in mice using a gene delivery device produced an increase in muscle mass and strength without affecting IGF-1 serum concentrations.[149] Due to this, athletes are experimenting with IGF-1 as an ergogenic aid.

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136. *Id.* at 418.
137. *Id.*
138. Arnold, *supra* note 132, at 320.
139. Nelson & Ho, *supra* note 126, at 418.
140. Arnold, *supra* note 132, at 320.
141. Graham et al., *supra* note 16, at 521.
142. Nelson & Ho, *supra* note 126, at 422.
143. *Id.*
144. *Id.* at 422-23.
145. *Id.* at 423.
146. *Id.*
147. Barroso et al., *supra* note 93, at 394.
148. *Id.*
149. *Id.*

2. Insulin

Insulin is a hormone secreted by the pancreas, which controls the uptake, utilization, and storage of glucose, amino acids, and fatty acids by various cells of the body.[150] Insulin-deficient patients suffering from Type-1 diabetes are the primary users of exogenous insulin.[151] Use of insulin by athletes is a "very risky endeavor" because it can cause a variety of side effects, such as hypoglycemia, the result of which can be coma or death.[152] Despite this, athletes use insulin because of its potential performance enhancing effects. Insulin can increase the rate of glucose uptake in muscle tissue, thus promoting an anabolic effect and improving exercise recovery.[153]

The detection of insulin in both the urine and blood presents significant challenges. Hemolysis and/or anti-insulin antibodies can interfere with an accurate blood analysis of insulin.[154] Classic methods of determining insulin doping in urine samples using RIA have been difficult to confirm due to problems differentiating synthetic and endogenous insulin.[155] WADA has recently supported a new analytical method using LC-MS for the identification of synthetic insulin in urine.[156]

3. Erythropoietin

Erythropoietin (EPO) "is a glycoprotein hormone that is mainly produced by the kidney and is a key regulator of red blood cell [(RBC)] production."[157] Synthetic EPO was approved for human use in 1989 for treating anemia.[158] Athletes use EPO in hopes of increasing their blood's oxygen-carrying capacity and, in turn, improve endurance and athletic performance.[159] EPO use has a storied history, with the first suspected cases in cycling deaths in the 1980s.[160] Since then, EPO doping by elite athletes has made frequent headlines.[161]

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150. LLEWELLYN, *supra* note 55, at 518.
151. Barroso et al., *supra* note 93, at 397.
152. LLEWELLYN, *supra* note 55, at 518, 520.
153. Barroso et al., *supra* note 93, at 397.
154. *Id.*
155. *Id.* at 397-98.
156. *Id.* at 398.
157. *Id.* at 396.
158. REENTS, *supra* note 21, at 204.
159. *Id.*
160. Barroso et al., *supra* note 93, at 396.
161. ASSAEL, *supra* note 25, at 159, 188.

Methods for detecting use of synthetic EPO include a combination of direct and indirect approaches.[162] The direct method is based on differences between the pattern and extent of glycosylation (glucose residues) in exogenous EPO compared to endogenous EPO.[163] The indirect method measures changes in hematological parameters of red blood cell production.[164] There are different testing procedures for the indirect method that can detect EPO use from forty-eight hours post-injection up to two weeks after EPO withdrawal.[165] During the 2000 Olympics, a combination of direct and indirect methods were implemented to detect EPO in blood samples, but since 2004, only the direct, urine-based method of EPO testing has been used.[166]

WADA is currently sponsoring research efforts directed at improving the indirect EPO method, as well as funding development of software that will improve the interpretive results from the direct method.[167] WADA is also searching for alternative analysis methods that may help detect EPO doping.[168]

E. Clinical Exemptions for the Use of Androgens by Athletes

In 1992, the IOC agreed to allow prohibited substances to be used for legitimate medical purposes.[169] Known as the Therapeutic Use Exemption (TUE), an athlete requires an expert medical assessment with a number of conditions to be met.[170] For example, androgen deficiency is treated with T and must be administered carefully, especially to strength athletes where androgen use can have a significant advantage.[171]

F. Future Trends

There are several new classes of hormone agonists, antagonists, and modifiers currently in testing and production. Selective androgen modulators (SARMs) act as agonists in the androgen receptor in muscle and bone with minor effects on the other organs, thus avoiding the negative side effects

162. Barroso et al., *supra* note 93, at 396.
163. *Id.*
164. *Id.* at 397.
165. *Id.*
166. *Id.*
167. *Id.*
168. *Id.*
169. Fitch, *supra* note 1, at 389.
170. *Id.*
171. *Id.*

associated with AAS.[172] WADA prohibited SARMs in sport starting January 1, 2008.[173]

Myostatin is a secreted protein in the body that plays a central role in skeletal muscle growth.[174] Inhibiting the myostatin gene will produce muscle growth in both animals and humans.[175] Although years away from production, myostatin inhibitors have the potential to become powerful doping agents to athletes. WADA has included myostatin inhibitors on the Prohibited List and is currently funding research for their detection.[176]

The "athlete passport" was recently proposed as a future method of drug testing that documents the biological profile of an individual athlete over time.[177] By establishing baseline values, future tests could then be used to detect abnormalities that differ from the baseline levels. "This approach would eliminate the inter-individual variability observed in the population-derived ranges currently used."[178]

The Union Cycliste Internationale (UCI) has adopted the "passport" approach as part of its anti-doping program to curtail the use of EPO.[179] This approach would have the potential to increase the sensitivity of testing procedures such as the hGH-responsive marker approach.[180] Finally, it could also be advantageous in the use of detecting natural androgens that rely on ratio testing such as the T/E ratio test.

A potential problem with the "passport" approach involves young athletes. Many sports, such as gymnastics, swimming, diving, and figure skating, involve athletes much younger than eighteen. The youngest athletes competing for the U.S. in the 2008 Olympic Games were fifteen years old.[181] At this age, humans are still going through natural growth and hormonal changes. To establish a baseline using tests from these athletes would create an inaccurate baseline. As a result, these baselines could be high or low, allowing some athletes an advantage and putting others at a disadvantage in future testing. The logical solution would be to not use the "passport" on athletes below a minimum age. However, it would be legally questionable to

172. *Id.*

173. World Anti-Doping Code, *supra* note 85, § 1(2).

174. Barroso et al., *supra* note 93, at 398.

175. *Id.*

176. *Id.* at 399.

177. Nelson & Ho, *supra* note 126, at 423.

178. Barroso et al., *supra* note 93, at 397.

179. *Id.*

180. Nelson & Ho, *supra* note 126, at 423.

181. Brian Cazeneuve, *Meet Team USA*, SPORTS ILLUSTRATED, July 28, 2008, at 80.

have a doping policy that applied differently between one group of athletes and another.

III. THE LEGAL BARRIERS

The legal barriers to accurate drug testing confound the myriad of physiological obstacles that exist to create and sustain accurate drug testing. Whether a test can be performed at all and whether that test is admissible in a court of law are both of concern. Just because science has invented a method for detecting an ergogenic aid does not mean that the test is lawful or that the results of that test can be enforced.

A. Constitutional Concerns

The Fourth Amendment of the United States Constitution protects people "against unreasonable searches and seizures"[182] and requires that lawful searches have a warrant, which can be issued only "upon probable cause, supported by [o]ath or affirmation, and . . . describing the place to be searched, and the persons or things to be seized."[183]

Multiple cases have found that obtaining bodily fluids is a seizure that is protected under the Fourth Amendment. In *Skinner v. Railway Labor Executives' Ass'n*,[184] the United States Supreme Court concluded that urine testing "intrudes upon expectations of privacy that society has long recognized as reasonable."[185] The Supreme Court has also held that a blood test "plainly involves the broadly conceived reach of a search and seizure under the Fourth Amendment."[186]

However, constitutional protections only apply when either a government entity or private organization acting in the government's place is carrying out the search.[187] They do not apply to searches and seizures conducted by private parties, regardless of whether they are based on any degree of suspicion or are simply arbitrary.[188] Whether the Fourth Amendment applies to sport organizations may very well depend on the organization and the laws that govern the organization.

182. U.S. CONST. amend. IV.

183. *Id.*

184. Skinner v. Ry. Labor Executives' Ass'n, 489 U.S. 602 (1989).

185. *Id.* at 617.

186. Schmerber v. California, 384 U.S. 757, 767 (1966).

187. *Skinner*, 489 U.S. at 613-14.

188. *Id.* at 614.

1. State Actors v. Government Agents

There are two ways that a private party can be required to grant constitutional protections to individuals: if the private party is determined to be either a state actor or a government agent. Although the two are related, the criteria that must be met are different for each. The tests for being a state actor are more difficult to satisfy than those for being a government agent.

a. State Actor

Four different tests have been used to determine whether a private organization is a state actor.[189] These tests are "(1) the public function test[,] (2) the state compulsion test[,] (3) the close nexus or symbiotic relationship test[,] and (4) the entwinement test."[190]

i. Public Function Test

The Supreme Court created the public function test in *Rendell-Baker v. Kohn*.[191] The purpose of this test is to determine whether the function being carried out by the private entity "has been 'traditionally the exclusive prerogative of the State,'"[192] with the emphasis on the word "exclusive." Since both private groups and the government have traditionally carried out many functions, this requirement that the function be exclusive to the government limits the applicability of this test in many situations.[193]

ii. State Compulsion Test

The state compulsion test examines whether the state "exercised coercive power or . . . provided such significant encouragement, either overt or covert, that the choice must in law be deemed to be that of the State,"[194] not of the private party. Thus, whether the private party is a state actor depends on a totality of the elements involved.[195]

189. Bradley T. French, Comment, *Charter Schools: Are For-Profit Companies Contracting for State Actor Status?*, 83 U. DET. MERCY L. REV. 251, 263 (2006).

190. *Id.*

191. Rendell-Baker v. Kohn, 457 U.S. 830, 842 (1982).

192. French, *supra* note 189, at 263 (quoting *Rendell-Baker*, 457 U.S. at 842).

193. *Id.*

194. Blum v. Yaretsky, 457 U.S. 991, 1004 (1982).

195. French, *supra* note 189, at 264.

iii. Entwinement Test

The entwinement test is a newer test, developed in *Brentwood Academy v. Tennessee Secondary School Athletic Ass'n.*[196] This test determines a private party to be a state actor when the "nominally private character of the [a]ssociation is overborne by the pervasive entwinement of public institutions and public officials in its composition and workings, and there is no substantial reason to claim unfairness in applying constitutional standards to it."[197]

iv. Close Nexus or Symbiotic Relationship Test

The close nexus or symbiotic relationship test is essentially an amalgamation of the public function, state compulsion, and entwinement tests. It takes into consideration all components involved in these three tests to determine whether the relationship between the state and the private "entity to be regulated are so pervasive as to hold that the entity has functionally 'merged' with the state."[198]

b. Government Agent

In determining whether a private party is an agent of the government, courts use a more subjective test that examines "the degree of the Government's participation in the private party's activities."[199] Furthermore, "[c]onstitutional provisions for the security of person and property are to be liberally construed, and 'it is the duty of courts to be watchful for the constitutional rights of the citizen, and against any stealthy encroachments thereon.'"[200]

Federal laws that mandate that private organizations perform some action that an organization may or may not perform without such a mandate, especially those actions that involve protected interests and rights, make the private organization into a government agent when performing the required action. A law that is "intended to supersede 'any provision of a collective bargaining agreement'"[201] and, thus, prevents a private organization from creating its own rules and regulations, is indicative of government

196. Brentwood Acad. v. Tenn. Secondary Sch. Athletic Ass'n, 531 U.S. 288, 288-89 (2001).

197. *Id.* at 298.

198. French, *supra* note 189, at 265.

199. Skinner v. Ry. Labor Executives' Ass'n, 489 U.S. 602, 614 (1989).

200. Byars v. United States, 273 U.S. 28, 32 (1927) (citing Boyd v. United States, 116 U.S. 616, 635 (1886)).

201. *Skinner*, 489 U.S. at 615.

encouragement, endorsement, and/or participation in the business of the organization, thus subjecting the organization to the Fourth Amendment.[202]

Thus, in order for a private organization to be considered a government agent for some action, it needs only to be performing that action in place of the government or at the government's direction.

2. Professional and Collegiate Sport

Professional sport leagues are generally considered to be private organizations. They are composed of private individuals engaging in the business, management, and execution of a professional sport, in which the federal government has never been involved.

There is no case that states that professional sport leagues are anything other than private entities. In fact, the *Oakland Raiders, Inc.*[203] case confirms that courts view leagues as private entities, because the court considered the law of private organizations as primary in that case and declined to involve itself in the inner workings of the National Football League.[204] Thus, professional sport leagues and teams in the United States do not have to abide by constitutional protections and are free to perform whatever searches they deem necessary, at anytime they choose (although restrictions may be placed upon this through collective bargaining with a player's union that sets criteria for drug testing).[205]

However, as Congress examines whether to mandate drug testing in professional sports, this freedom that teams and leagues have from constitutional considerations may change. Once the government has mandated that drug testing occur, how that testing is carried out becomes a constitutional issue, as the leagues carrying out such testing will be acting as agents of the government.[206]

The government may want the names of those who test positive, want to know what substances they tested positive for, and fine leagues that do not

202. *Id.* at 615-16.

203. Oakland Raiders, Inc. v. Nat'l Football League, 32 Cal. Rptr. 3d 266, 284 (Ct. App. 2005).

204. *Id.*

205. *See generally* David M. Wachutka, *Collective Bargaining Agreements in Professional Sports: The Proper Forum for Establishing Performance-Enhancing Drug Testing Policies*, 8 PEPP. DISP. RESOL. L.J. 147, 165-66 (2007). Wachutka argues that collective bargaining is the preferred method of creating drug policy in professional sport, because "it allows the parties to negotiate their own rights" and "it eliminates . . . constitutional issues that may arise if the policy is implemented through other means." *Id.* at 165.

206. Lindsey J. Taylor, *Congressional Attempts to "Strike Out" Steroids: Constitutional Concerns About the Clean Sports Act*, 49 ARIZ. L. REV. 961, 965 (2007).

comply with the federal drug testing laws.[207] All of these would be further evidence that the federal government has become involved in the business of a private organization and has turned that organization into a government agent.[208]

Collegiate sports are treated similarly to professional sport leagues. The National Collegiate Athletic Association (NCAA) is considered to be a private organization,[209] and thus, is not required to grant constitutional protections to the student-athletes at its member schools. Legislation requiring drug testing would affect the NCAA similarly to professional sport leagues, by making the NCAA a state agent, unless such legislation specifically exempted the NCAA, collegiate, or amateur sport organizations.

3. Olympic Sports

a. United States Olympic Committee

In *San Francisco Arts & Athletics, Inc. v. United States Olympic Committee*,[210] the Supreme Court affirmed the Ninth Circuit's conclusion that the United States Olympic Committee (USOC) is not a state actor. The court stated that:

> The fact that Congress granted it a corporate charter does not render the USOC a Government agent. All corporations act under charters granted by a government, usually by a State. They do not thereby lose their essentially private character. Even extensive regulation by the government does not transform the actions of the regulated entity into those of the government. Nor is the fact that Congress has granted the USOC exclusive use of the word "Olympic" dispositive. All enforceable rights in trademarks are created by some governmental act, usually pursuant to a statute or the common law. The actions of the trademark owners nevertheless remain

207. *Id.*

208. *See id.* at 965-66.

209. *See, e.g.*, NCAA v. Tarkanian, 488 U.S. 179, 197 (1998) (stating that the NCAA is private actor that "enjoy[s] no governmental powers"); Hill v. NCAA, 865 P.2d 633, 641 (Cal. 1994) (stating that "the NCAA as a private organization, comprised of American colleges and universities, and democratically governed by its own membership"); Arlosoroff v. NCAA, 746 F.2d 1019, 1021 (4th Cir. 1984) (stating that the NCAA is "a voluntary association of public and private institutions"); O'Halloran v. Univ. of Wash., 679 F. Supp. 997, 1001 (W.D. Wash. 1988), *rev'd on other grounds*, 856 F.2d 1375 (9th Cir. 1988) (stating that the NCAA is private entity).

210. S. F. Arts & Athletics, Inc. v. U.S. Olympic Comm., 483 U.S. 522, 547-48 (1987).

> private. Moreover, the intent on the part of Congress to help the USOC obtain funding does not change the analysis. The Government may subsidize private entities without assuming constitutional responsibility for their actions.
>
> This Court also has found action to be governmental action when the challenged entity performs functions that have been "'traditionally the *exclusive* prerogative'" of the Federal Government. Certainly the activities performed by the USOC serve a national interest, as its objects and purposes of incorporation indicate. The fact "[t]hat a private entity performs a function which serves the public does not make its acts [governmental] action." The Amateur Sports Act was enacted "to correct the disorganization and the serious factional disputes that seemed to plague amateur sports in the United States." The Act merely authorized the USOC to coordinate activities that always have been performed by private entities. Neither the conduct nor the coordination of amateur sports has been a traditional governmental function.[211]

However, the court's rejection of the USOC as a state actor does not mean that the USOC is not a government agent, because the standard for being a state actor is higher. If the federal government were to pass legislation requiring sport organizations to perform mandatory drug testing on its athletes, and if that law were to apply to amateur and Olympic sports, then the USOC would be made into a state actor, just as the professional leagues and the NCAA would be. However, whether the USOC is already an agent of the government, and thus, required to adhere to constitutional rights and protections, is an open question.[212]

The USOC was created through federal legislation[213] and is specifically stated to be "a federally chartered corporation."[214] Among the purposes for the existence of the USOC are "to obtain for the United States . . . the most competent amateur representation possible in each event of the Olympic Games, the Paralympic Games, and Pan-American Games"[215] and to preside

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211. *Id.* at 543-45 (citations omitted).

212. *See* Hilary Joy Hatch, *On Your Mark, Get Set, Stop! Drug-Testing Appeals in the International Amateur Athletic Federation*, 16 LOY. L.A. INT'L & COMP. L.J. 537, 564 n. 180 (1994).

213. Ted Stevens Olympic and Amateur Sports Act, 36 U.S.C. §§ 220501-220529 (1998).

214. *Id.* § 220502(a).

215. *Id.* § 220503(4).

over "all matters pertaining to United States participation in [those games], including representation of the United States in the games."[216]

These purposes indicate that the USOC is the representative of the United States government in the Olympic arena, and the Ted Stevens Act directly states that "[t]he USOC may represent the United States as its national Olympic committee in relations with the International Olympic Committee and the Pan-American Sports Organization and as its national Paralympic committee in relations with the International Paralympic Committee."[217] Other sections grant the USOC power in certifying national governing bodies (NGBs) for each sport[218] and overseeing other international competition by American athletes.[219]

All of these provisions appear to make the USOC an agent of the U.S. government and, as such, obligated to grant constitutional protections. However, until an athlete challenges the USOC's right to drug test without reasonable suspicion or a warrant, and the USOC is found to be a government agent, the USOC will continue to avoid the restrictions of the Constitution.

Unless the courts determine otherwise, or the federal government mandates drug testing, professional, collegiate, and Olympic sport organizations do not have any constitutional barriers to administering drug tests to their athletes. However, the USOC does not actually administer drug tests to its athletes; it only creates procedures and enforces penalties when doping violations are discovered. The United States Anti-Doping Agency (USADA) is the actual entity that administers drug tests to athletes involved in Olympic sports and organizations.

b. United States Anti-Doping Agency

USADA was created to address "gross shortcomings" in the USOC's drug testing program.[220] Prior to USADA, the USOC administered drug tests, but each sport's NGB was left to discipline athletes for doping violations under

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216. *Id.* § 220503(3)(A).

217. *Id.* § 220505(c)(2).

218. *Id.* § 220521.

219. *Id.* § 220505(c)(1).

220. Dionne L. Koller, *Health Law Symposium: Does the Constitution Apply to the Actions of the United States Anti-Doping Agency?*, 50 ST. LOUIS U. L.J. 91, 105 (2005). This article provides a thorough and detailed analysis of whether USADA would be deemed a state actor by a court and concludes that, although there are specific circumstances where USADA's actions may be deemed as acting on behalf of the state, in general, USADA is not a government entity and cannot be deemed a state actor. The article makes no references to whether USADA could be considered a government agent, however.

the NGB's own procedures.[221]

The result was a conflict of interest, where the entities that tested and disciplined athletes for doping offenses were also the entities responsible for the selection of national teams.[222] At that time, there was a general belief at the international level that the USOC and its affiliated NGBs had protected those participating in doping and even helped them cheat.[223] As a result of this situation, Congress and the Office of National Drug Control Policy (ONDCP) worked together to create USADA, with the support of the USOC.[224]

USADA is designated as a private, non-profit organization that administers the United States's drug testing program via a contractual agreement between itself and the USOC.[225] USADA has the freedom to test:

a. Any athlete who is a member of a NGB;
b. Any athlete participating at a competition sanctioned by the USOC or a NGB;
c. Any foreign athlete who is present in the United States; or
d. Any other athlete who has given his/her consent to testing by USADA or who has submitted an out-of-competition testing location form to USADA or an IF within the previous twelve months and has not given his or her NGB and USADA written notice of retirement;
e. Any athlete who has been named by the USOC or an NGB to an international team or who is included in the USADA Registered Testing Pool or is competing in a qualifying event to represent the USOC or NGB in international competition;
f. Any United States athlete or foreign athlete present in the United States who is serving a period of ineligibility on account of an anti-doping rule violation and who has not given prior written notice of retirement from all sanctioned competition to the applicable NGB and USADA, or the applicable foreign anti-doping agency or foreign sport association.[226]

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221. *Id.* at 98.
222. *Id.*
223. *Id.* at 97.
224. *Id.* at 95-6, 106.
225. *Id.* at 108.
226. United States Anti-Doping Agency, *Protocol for Olympic Movement Testing*, 1-2, Aug. 13,

As a result, USADA has the ability to test virtually all amateur and professional athletes involved in an Olympic sport.

By being designated as a private entity, and not a government organization, USADA is able to avoid granting constitutional protections to the athletes it tests.[227] However, if USADA were designated as a state actor or government agent, then it would have to abide by constitutional limitations.[228] There are no cases stating that USADA is a state actor, so until there is such a case, it will remain a private entity. Whether USADA could be considered a government agent is a separate issue.

Arguments in support of USADA being a government agent include, "Congress has designated USADA as the 'official anti-doping agency' for the United States,"[229] Congress has given USADA the exclusive right to perform and sanction drug tests on all athletes,[230] the majority of USADA's operating budget is received from the federal government,[231] and "USADA was created to fulfill important government objectives, [and] the federal government has a continuing interest in and influence over its operations."[232]

Arguments that support the contention that USADA is not a government agent include, USADA is not a government corporation, but is incorporated in Colorado,[233] the U.S. government has never been directly involved in drug testing and got involved with creating USADA only because the USOC's program was ineffective,[234] and USADA's day-to-day activities are neither overseen nor controlled by the federal government.[235]

These arguments, however, only support the contention that USADA is not a state actor. Since the requirements for being considered a state actor are lower than those for being a government agent, failure to meet the state actor test does not equate with failure to meet the government agent test.

There is little question that the USADA runs the United States's drug testing program at the government's direction. The fact that the U.S. Congress and ONDCP created USADA with the mandate that it is "the United States's

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2004, *available at* http://videos.usoc.org/documentsnotices/protocol.pdf.

227. Koller, *supra* note 220, at 109.

228. *Id.*

229. *Id.* at 112.

230. *Id.* at 117.

231. *Id.* at 120.

232. *Id.* at 128.

233. *Id.* at 113.

234. *Id.* at 95-96, 106, 122.

235. *Id.* at 125.

'official' anti-doping agency" [236] is evidence that USADA's existence and its actions are at the direction of the government. Furthermore, the specific actions that USADA takes are very similar to those that Congress expressed should be taken by a national doping agency.

In October 1999, Senator John McCain stated that "[t]esting must be universal in that all athletes wishing to compete in the Olympic games should be required to submit to the testing regime established by this independent agency . . . [and] a comprehensive and sustained anti-drug and sports ethics education program should be developed and implemented."[237]

Currently, USADA does test all athletes involved with Olympic sports, both during and out of season,[238] and education focusing on the ethics of using performance enhancing drugs is listed as one of USADA's four primary focuses.[239] The fact that USADA has adopted Congress's goals for such an organization is further evidence that USADA could be deemed a government agent, acting in place of or at the government's direction. This would make USADA subject to constitutional limitations.

4. Recent Development

On August 4, 2008, President George W. Bush signed the United Nations Educational, Scientific and Cultural Organization's (UNESCO) International Convention against Doping in Sport (the Convention).[240] The U.S. became the ninetieth country to sign onto the Convention,[241] which states that its purpose "is to promote the prevention of and the fight against doping in sport, with a view to its elimination."[242]

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236. *Id.* at 122.

237. *Id.* at 105 (citing *Effects of Performance Enhancing Drugs on the Health of Athletes and Athletic Competition: Hearing Before the S. Comm. on Com., Sci., & Transp.*, 106th Cong. 23 (1999), *available at* http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=106_senate_hearings&docid=f:75594.pdf).

238. United States Anti-Doping Agency, *supra* note 226, at 3-4.

239. USADA, *USADA Mission*, USANTIDOPING.ORG, June 8, 2008, http://www.usantidoping.org/who/mission.html.

240. United Nations Educational, Scientific and Cultural Organization, *United States Ratifies International Convention against Doping in Sport*, UNESCO.ORG, http://portal.unesco.org/en/ev.php-URL_ID=43227&URL_DO=DO_TOPIC&URL_SECTION=201.html (last visited Aug. 6, 2008) [hereinafter *UNESCO*]. This treaty was signed four days before the deadline for this article and a full analysis of its impact and possible repercussions was simply not possible given the limited time available.

241. *Id.*

242. United Nations Educational, Scientific and Cultural Organization, *International Convention against Doping in Sport 2005*, UNESCO.ORG, http://portal.unesco.org/en/ev.php-URL_ID=31037&URL_DO=DO_TOPIC&URL_SECTION=201.html (last visited Aug. 6, 2008) [hereinafter ICADIS

The Convention provides several means of achieving its purpose, including that the nations who are party to the Convention "adopt appropriate measures at the national and international levels, which are consistent with the principles of the [WADA] Code."[243] The Convention further defines these measures as including, but not limited to, "legislation, regulation[s], policies or administrative practices."[244] Finally, it states that the signatory nations "commit themselves to the principles of the [WADA] Code as the basis for the measures provided for in Article 5."[245]

Given that the U.S. Senate approved ratification of the Convention on July 22, 2008,[246] the Convention constitutes a treaty. A treaty is binding on the states as "the supreme Law of the Land."[247] By agreeing to adopt WADC at a national level, making it essentially the national law on doping, it appears that the U.S. government has involved itself in drug testing and regulation sufficiently to cause those entities and organizations that perform and enforce drug testing on athletes to be deemed state actors.

Both the state compulsion and the close nexus tests can be met by the existence of this treaty, and presumably, the subsequent legislation that will be forthcoming. Once there is law regarding doping, it is obvious that the state is compelling organizations to abide by specific standards, and it can be strongly argued that the government has regulated doping so pervasively that those organizations involved in doping control and testing could be deemed to be "functionally 'merged' with the state."[248]

As the repercussions of this treaty begin to manifest themselves, the USOC, USADA, and perhaps even professional sports leagues and the NCAA could find themselves to be state actors, obligated to grant their members and employees constitutional protections.

B. The Admissibility of Scientific Evidence in Court

Simply because an entity has the right to administer a drug test and simply because a test has been devised that detects some drug, does not mean that the test given, if challenged in a court of law, will be admissible or valid. Development by science does not guarantee acceptance by the law.

2005].

243. *Id.* art. 3(a).

244. *Id.* art. 5.

245. *Id.* art. 4(1).

246. ICADIS 2005, *supra* note 242.

247. U.S. CONST. art. VI, cl. 2.

248. French, *supra* note 189, at 265.

1. Tests for Admissibility of Scientific Evidence

Several different tests are used to determine whether given scientific evidence is admissible in court: 1) the relevancy standard; 2) the *Frye* or general acceptance test; and 3) the *Daubert* test.

a. The Relevancy Standard

The main purpose of the relevancy test is to determine whether scientific evidence is relevant to a given case. The relevancy test generally consists of three basic questions: "(1) is it relevant; (2) is the witness a qualified expert; and (3) will the evidence assist the trier of fact."[249]

The primary purpose of this test is to determine whether the person testifying about the scientific evidence is an expert.[250] The underlying scientific principles and procedures are admissible, and their credibility is assessed based on the expert witness testimony and cross-examination.[251]

b. The Frye Test

The *Frye* test is also known as the general acceptance test.[252] The purpose is to determine whether the scientific evidence in question has been "sufficiently established to have gained general acceptance in the particular field in which it belongs."[253] Instead of relying on expert witnesses to determine whether a scientific principle or process is admissible, the court has the scientific community, as a whole, "determine if the proposed scientific evidence has met with enough general acceptance so as to be reliable for use in a court of law."[254] In order to determine whether proffered scientific evidence has been generally accepted in the scientific community, courts employ a test comprised of three prongs.

The first prong asks the general question of "whether there is a generally accepted theory in the scientific community that supports the contention proposed."[255] The second prong asks whether there are already generally

249. Michael A. Riley, *How Should North Dakota Approach the Admissibility of DNA: A Comprehensive Analysis of How Other Courts Approach the Admissibility of DNA*, 72 N. D. L. REV. 607, 624 (1996) (citing State v. Peters, 534 N.W.2d 867, 872 (Wis. 1995)).

250. *Id.*

251. State v. Peters, 534 N.W.2d 867, 872 (Wis. 1995).

252. Riley, *supra* note 249, at 617.

253. Frye v. United States, 293 F. 1013, 1014 (D.C. Cir. 1923).

254. Riley, *supra* note 249, at 617.

255. Jeffery A. Norman, Comment, *DNA Fingerprinting: Is It Ready for Trial?*, 45 U. MIAMI L. REV. 243, 248 (1990).

accepted techniques capable of producing reliable results in the specific scientific field at issue.[256] In the final prong, the court examines whether the specific processes and procedures of the scientific method at issue were followed properly in each individual case.[257]

The purpose of the *Frye* test is to determine whether the science behind specific evidence is valid, has been obtained in a reliable way, and is supported by the scientific community.

c. The Daubert Test

The most recent of the tests for the admissibility of scientific evidence is the *Daubert* test, established in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*[258] This is the only test used in the federal courts because it supersedes *Frye.*[259] Half a century after *Frye* was established, the Federal Rules of Evidence were created.[260] Rule 702 of the Federal Rules of Evidence applies to scientific evidence.[261] It states that "[i]f scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise."[262]

The Court went on to further define and clarify Rule 702 by stating that "'scientific' implies a grounding in the methods and procedures of science"[263] and that "'knowledge' connotes more than subjective belief or unsupported speculation."[264] The purpose is to require "that an expert's testimony pertain to 'scientific knowledge' establishes a standard of evidentiary reliability."[265] Finally, the Court concluded that whether evidence "will assist the trier or fact" speaks to the relevance of the proffered evidence to the facts of the case at hand.[266]

With these parameters established, the Court created a four-part test to determine the admissibility of scientific evidence: 1) whether it has been or

256. *Id.*
257. *Id.*
258. *See generally* Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579 (1993).
259. Riley, *supra* note 249, at 620.
260. *Daubert*, 509 U.S. at 587.
261. Riley, *supra* note 249, at 620.
262. FED. R. EVID. 702.
263. *Daubert*, 509 U.S. at 590.
264. *Id.*
265. *Id.*
266. *Id.* at 591.

can be tested;[267] 2) "whether the theory or technique has been subjected to peer review and publication";[268] 3) what the rate of known error is;[269] and 4) whether the technique or knowledge has been generally accepted in the scientific community.[270] This test permits the court to examine the methodology and reasoning behind the proffered evidence and determine whether the evidence fits with the facts of the specific case before the court.[271]

2. Applicability of Scientific Admissibility Tests to Doping Cases

Whether a specific drug test is admissible in a court of law as scientific evidence of an athlete's doping would depend on which of the preceding tests were applied to the case. In *most* cases, the *Daubert* test is the test that would apply. This is because most of the sport organizations involved in drug testing are interstate organizations.

The USOC's charter specifically states that:

> [A]ny civil action brought in a State court against the corporation [the USOC] and solely relating to the corporation's responsibilities . . . shall be removed, at the request of the corporation, to the district court of the United States in the district in which the action was brought, and such district court shall have original jurisdiction over the action without regard to the amount in controversy or citizenship of the parties involved.[272]

To demonstrate the difference in admissibility between doping tests, the *Daubert* test will be applied to both the hGH-responsive marker test and the GC-MS test. Based on the following analyses, it would appear that the hGH-responsive marker test does not meet the criteria for admissible scientific evidence, whereas the GC-MS test does (and already has).

The first prong of the *Daubert* test, which inquires whether a substance has been or can be tested, is met by the hGH-responsive marker test. The test

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267. *Id.* at 593.

268. *Id.*

269. *Id.* at 594.

270. *Id.*

271. Riley, *supra* note 249, at 621.

272. 36 U.S.C. § 220505(b)(9). A search of LexisNexis with the only search parameter "United States Olympic Committee" as a party in the case revealed sixty-four cases, fifty-two of which were federal court decisions. The remaining twelve cases include three denials to hear by the Michigan Supreme Court and four related to injuries while working or practicing, among others. Only one case involves a positive drug test being appealed, although the accuracy of the drug test is not at issue. *See* Walton-Floyd v. U.S. Olympic Comm., 965 S.W.2d 35 (Tex. App. 1998).

definitely tests for something measurable, namely IGFBP-3 and collagen peptides.[273]

hGH-responsive marker testing has not been the subject of many peer-reviewed publications. There are only a few articles that mention it, and most of those articles speak of it as a future method of testing.[274] Just two articles could be found that actually applied the hGH-responsive marker test to a clinical test, and the same researchers performed both of these tests.[275] At this point, there is little published support for hGH-responsive marker testing.

The most difficult prong for the hGH-responsive marker test to satisfy is the requirement regarding the rate of known error. The stated error rate of fourteen percent for males and forty percent for females[276] is incredibly high. Furthermore, the doses administered have to be significantly above natural physiological amounts to register even these failure rates.[277] Presumably, lower doses would have an even higher rate of inaccurate results.

Although there is no set rate of error that is required to satisfy a *Daubert* test, and the rate of error should not be considered "a litmus test for determining the admissibility of an expert's work,"[278] a test that fails to register an accurate positive test for almost half of the people tested cannot be considered a reliable test. To determine whether the error rate of a given scientific procedure is reasonable, the error rate can be compared against the error rates of other procedures that serve the same purpose.[279] The error rate of other tests used to detect doping by athletes include T/E ratio tests having 4% false positives and 46% false negatives,[280] and T/LH ratio tests having a 13% rate of false positives and 24% of false negatives.[281] A study of EPO testing labs revealed that some labs failed to detect 100% of doping in athletes

273. Nelson & Ho, *supra* note 126, at 418; Arnold, *supra* note 132, at 320.

274. *See, e.g.*, Nelson & Ho, *supra* note 126; Graham et al., *supra* note 16, at 520-21.

275. *See generally*, A. E. Nelson et al., *Influence of Demographic Factors and Sport Type on Growth Hormone-Responsive Markers in Elite Athletes*, 91 J. CLINICAL ENDOCRIN. & METAB. 4424 (2006) [hereinafter *Influence*]; A. E. Nelson et al., *Erythropoietin Administration Does Not Influence the GH–IGF Axis or Makers of Bone Turnover in Recreational Athletes*, 63 CLINICAL ENDOCRIN. 305 (2005) [hereinafter *EPO Does Not Influence*].

276. Graham et al., *supra* note 16, at 521.

277. *Id.*

278. Cook v. Rockwell Int'l Corp., No. 90-cv-00181-JLK, 2006 U.S. Dist. LEXIS 89121, at *69 n. 25 (D. Colo. 2006).

279. In re TMI Litigation Cases Consolidated II, 911 F. Supp. 775, 802 (M.D. Pa. 1996).

280. Paul J. Perry et al., *Detection of Anabolic Steroid Administration: Ratio of Urinary Testosterone to Epitestosteronė vs the Ratio of Urinary Testosterone to Luteinizing Hormone*, 43 CLINICAL CHEM. 731, 731 (1997).

281. *Id.*

who had been administered EPO.[282]

Furthermore, tests using hGH-responsive marker testing have found there to be variations in the results based on the age and gender of the athlete, and to a lesser degree on their ethnicity.[283] Given that the consequences of failing this test can be the loss of an athlete's sporting career, the failure rate is too high to be deemed reliable scientific evidence.

When there are few scientific studies to support a testing method and few authors have discussed the specific method, it is difficult to argue that the scientific community has generally accepted the scientific procedure in question. hGH-responsive marker testing does not yet have the clinical research to support such acceptance.

Given that hGH-responsive marker testing can only meet the first prong of the *Daubert* test at this time, all results from using this test would have to be deemed inadmissible in a court of law. An athlete testing positive using this method would have grounds to argue that the testing procedure is invalid and unreliable.

In contrast, the GC-MS test meets all the criteria of the *Daubert* test. Like the hGH-responsive marker approach, GC-MS does test something that is measurable – the level of a certain drug, or drugs, in urinary excretions.

However, that is where the similarity to hGH-responsive marker testing ends. GC-MS has been subjected to extensive trials and publications that verify it as an accurate and reliable method of detecting drugs in urine. Members of the medical community have described it as the "'gold standard' in analytical chemistry."[284] The U.S. Court of Appeals for the Seventh Circuit stated that GC-MS is "probably the most accurate of the urinalysis tests; surveys have rated it as nearly infallible."[285] Although this Seventh Circuit decision predates *Daubert* by four years, the court's acceptance of GC-MS's accuracy speaks to the test's ability to stand up to a *Daubert* challenge.

The success rate for GC-MS is "essentially 100%," and it has a minimum scale error ratio.[286] This is because "each chemical has its own unique fragmentation pattern [and thus], a properly performed GC-MS analysis has a negligible likelihood of misidentifying a particular chemical."[287] The only

282. Carsten Lundby et al., *Testing for Recombinant Human Erythropoietin in Urine: Problems Associated with Current Anti Doping Testing*, J. APPL. PHYSIOL. (forthcoming), *available at* http://jap.physiology.org/cgi/reprint/90529.2008v1.

283. *See generally*, *Influence*, *supra* note 275.

284. Greenblatt, *supra* note 8, at 655.

285. Taylor v. O'Grady, 888 F.2d 1189, 1192 n.4 (7th Cir. 1989).

286. Greenblatt, *supra* note 8, at 655.

287. *Id.*

way that a false positive can be registered is if two drugs have identical retention times, and thus, appear to be the same substance.[288] However, the likelihood of such an occurrence is remote.[289]

Finally, the scientific community has generally accepted GC-MS. It was first used to test for athlete doping during the 1976 Montreal Olympic Games,[290] meaning that GC-MS is in its fourth decade as a testing method for doping. The fact that GC-MS is the "gold standard" further supports its acceptance by the members of the scientific community.[291]

Most tests that will be admissible under *Daubert* will be those tests that have stood the test of time. Only after repeated trial and publication is a test deemed to be generally accepted. Although the older, established tests might not be able to detect all drugs used for doping, those tests have a better chance of withstanding legal challenges than new tests that may have only limited research. By using tests that are valid in a court of law, those seeking to enforce the test results need only prove that the test was performed properly in the specific case at issue. This is a far easier challenge than proving the reliability and accuracy of the testing method itself.

IV. CONCLUSION

Whether completely accurate drug testing can ever be achieved is a serious question. With new drugs and detection methods being created constantly, the legal community will have difficulty keeping up and will often be behind the science. This lapse creates an opportunity for those who are determined to cheat.

It also creates the risk that athletes will have their reputations, careers, and livelihood ruined over drug test results that may not be based on the most accurate and reliable science. Court challenges can take years, and even if a player is exonerated because the testing method is invalid, the damage to their career and reputation would have already been done. Although many in the doping control field would have athletes, and the public, believe that testing is accurate, reliable, and unchallengeable, there are some in their own arena that disagree and are critical of the entire anti-doping system.

Donald A. Berry, a biostatistician and head of the Division of Quantitative Sciences at Texas's MD Anderson Cancer Center, argues that the anti-doping

288. *Id.* at 656.

289. *Id.*

290. Kammerer, *supra* note 2, at 4.

291. *See* Greenblatt, *supra* note 8, at 655.

sciences are "weak" and "something [he] regards not to be science."[292] He also contends that operating characteristics such as lab, sample handling, and interpretation errors, as well as machine malfunctions, make it difficult to know the true accuracy of drug testing.[293]

Berry is especially concerned about new testing procedures that test natural hormones, such as EPO and hGH, arguing that rigorous statistical research is required when using large population samples under similar competition-like conditions.[294] Matthew Slawson, director of the University of Utah Sports Medicine and Research Testing Laboratory, a WADA-approved lab, said that such large-scale testing "would be useful and very valuable, but very expensive."[295] Berry dismisses financial and other objections by putting it bluntly:

> If we cannot as a society afford to fund that sort of effort, then we ought not to be trying to make these measurements and ruin people's lives. . . . If we want to do it, then we have to do it right. Doing it in a half-assed way is not serving anybody.[296]

292. Brian Alexander, *Shaky Science Casts Doubt on Doping Results: As Olympics Begin, Researcher says Testing System is Critically Flawed*, MSNBC.COM, Aug. 6, 2008, http://www.msnbc.msn.com/id/26045416/.

293. *Id.*

294. *Id.*

295. *Id.*

296. *Id.*