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**GENE DOPING IN ATHLETICS: THE CURRENT PRACTICES
AND SUGGESTIONS FOR THE FUTURE**

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INTRODUCTION

Most Americans are familiar with scandals involving high profile athletes using banned drugs, or even blood doping in an effort to enhance athletic performance. However, few are familiar with a little-known technology that could become even more

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dangerous and more difficult to detect: gene doping. With this emerging technology, it is now possible to introduce a gene into an athlete's DNA that could enhance their athletic performance and leave little trace of its existence.

Gene doping use has been banned from use in the Olympic Games and in National Collegiate Athletic Association (NCAA) competitions.¹ Despite worldwide recognition of the inequity that gene doping could create in athletics, major professional athletic associations in the United States have failed to prohibit it.

Not only is gene doping currently allowed in professional athletics, it is also largely unregulated within the organizations that forbid it.² The potential of gene doping and genetic technology is virtually endless as it has the potential to change nearly any gene in the human body to enhance performance.³ Because there are endless possibilities with the gene that could be altered, there is no mechanism to monitor for all gene doping forms.⁴ Currently, the proposed method for monitoring alterations to the genetic makeup is to take a genetic sample from an athlete to create a "gene passport." This passport would create a reference which could be used to track any genetic changes, thus signaling that an athlete has been gene doping.

Professional associations should attempt to begin negotiating to ban gene doping. The WADA, and the NCAA should implement systems to begin testing for gene doping. Negotiations with payers' unions could take several decades, so introducing the idea of banning gene doping should happen as soon as possible. If these establishments do not ban the practice, players will be at risk for injuries and may burn out faster, while trade systems may crumble.

¹ *Athlete Guide to the 2020 Prohibited List*, U.S. ANTI-DOPING AGENCY, <https://www.usada.org/athletes/substances/prohibited-list/athlete-guide-to-the-2020-prohibited-list/> (last visited Dec. 30, 2020); *2020-21 NCAA Banned Substances*, NAT'L COLLEGIATE ATHLETIC ASS'N, <http://www.ncaa.org/sport-science-institute/topics/2020-21-ncaa-banned-substances> (last visited Dec. 24, 2020).

² See *Frequently Asked Questions About Drug Testing*, NCAA, <https://www.ncaa.org/sports/2014/3/25/frequently-asked-questions-about-drug-testing.aspx> (last visited Feb. 15, 2020) [hereinafter *Frequently Asked Questions*]. The NCAA and WADA both ban gene doping, but the NCAA does not test for gene doping, and WADA only tests for gene doping with regard to increased levels of EPO. *Id.*

³ See Lucy Battery et al., *Gene Doping: Olympic Genes for Olympic Dreams*, J. ROYAL SOC'Y MED. (Dec. 2011), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3241516/>.

⁴ See *id.*

Part II discusses the current regulations and testing those athletes comply with across different organizations, as well as the legal mechanism requiring athlete compliance. Part III explains the science behind gene doping and the expansive possibilities gene doping could have on the body. Part IV covers the suggestions regarding whether professional athletic organizations should adopt a ban on gene doping and how that could take place. This section also addresses the possible means by which gene doping could be further regulated and tested to ensure compliance with each organization's current testing provisions.

I. ATHLETIC ASSOCIATIONS: HOW DO THEY BAN DIFFERENT PRACTICES, WHY DO THEY BAN THEM, AND WHAT DO THEY BAN?

Doping and drug use have been banned within athletic associations for decades.⁵ There are legal mechanisms in place to ensure athletes consent to drug testing and adhere to the banned practice guidelines among the different associations.⁶ However, the basis of allowing the testing and monitoring for doping and drug use lies in contract law.⁷ Additionally, there are distinctive policy considerations for banning different practices. These policies could factor heavily into the particular associations' decisions that have already banned gene doping, and those that may consider banning gene doping in the future.

The following section explains the differences in rationales for various bans, the legal framework for banning different practices, precisely what is banned in those organizations, and current testing practices.

A. THE OLYMPIC CHARTER

Athletes participating in the Olympics must participate in drug and doping tests in compliance with the Olympic Charter, an agreement that countries and athletes agree to when they participate

⁵ See Claudia L. Reardon & Shane Creado, *Drug Abuse in Athletes*, SUBSTANCE ABUSE & REHAB. (Aug. 14, 2014), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4140700/>.

⁶ See, e.g., *Drugs and Testing*, USLEGAL, <https://sportslaw.uslegal.com/drugs-and-testing/> (last visited Feb. 8, 2022).

⁷ See Matthew Hard, Note, *Caught in the Net: Athletes' Rights and the World Anti-Doping Agency*, 19 S. CAL. INTERDISC. L.J. 533, 535-36 (2010), <https://gould.usc.edu/why/students/orgs/ilj/assets/docs/19-3%20Hard.pdf>.

in the Olympic Games.⁸ The Olympic Charter explains the Olympic Movement goals, which includes the International Olympic Committee (IOC) and National Olympic Committees (NOCs).⁹ The Olympic Charter requires complete compliance with the World Anti-Doping Agency and for athletes follow the World Anti-Doping Code.¹⁰

In 2009, WADA implemented the Athlete Biological Passport, which stores individual athletes' hematological information.¹¹ This biological passport began monitoring for steroid use in 2014, but current guidelines do not include monitoring for gene doping.¹² Current guidelines provide that athletes who are expected to participate in the Olympics allow for WADA to be tested at any place and at any time.¹³ Failure to comply with testing when a WADA official approaches an athlete for a sample, results in disqualification from participating in future games for a specified time.¹⁴

WADA can test athletes because countries agree to adhere to the testing and anti-doping guidelines by participating in the Olympics.¹⁵ Athletes also comply with testing requirements because they agree to the relevant terms when they compete, and because the punishment for non-compliance is a ban from competition.¹⁶ Courts in the United States have found that these contractual provisions are constitutional because participation in

⁸ See generally Int'l Olympic Comm., *Olympic Charter* (Aug. 8, 2021), https://stillmedab.olympic.org/media/Document%20Library/OlympicOrg/General/EN-Olympic-Charter.pdf#_ga=2.248398082.400855338.1605428713-849736782.1605428713.

⁹ *Id.* at 15.

¹⁰ See *id.* at 81-82.

¹¹ WORLD ANTI-DOPING AGENCY, *ATHLETE BIOLOGICAL PASSPORT OPERATING GUIDELINES 4* (2019), https://www.wada-ama.org/sites/default/files/resources/files/guidelines_abp_v71.pdf [hereinafter *ATHLETE BIOLOGICAL PASSPORT*].

¹² See generally *id.*

¹³ See *id.* at 10.

¹⁴ See Adam Kilgore, *World Champion Sprinter Christian Coleman is Banned from Tokyo Olympics for Missed Drug Tests*, WASH. POST (Oct. 27, 2020), <https://www.washingtonpost.com/sports/2020/10/27/world-champion-sprinter-christian-coleman-is-banned-tokyo-olympics-missed-drug-tests/>.

¹⁵ See *World Anti-Doping Code*, WORLD ANTI-DOPING AGENCY, <https://www.wada-ama.org/en/what-we-do/world-anti-doping-code> (last visited Feb. 10, 2022).

¹⁶ See *id.*

athletics is a privilege not a right, and therefore the requirements for participation act as the consideration within an agreement.¹⁷

For example, Chinese Olympic swimmer Sun Yang received an eight-year ban from participating in the Olympics for refusing to participate in a doping test without being notified beforehand.¹⁸ The three-time Olympian was met by three WADA officials in his hometown in 2018.¹⁹ After a vial of his blood was taken, Yang ordered his personal security guard to smash the blood vial.²⁰ Yang also refused to produce a urine sample.²¹ The swimmer had long been fighting to maintain his Olympic eligibility, but a panel unanimously decided in 2020 that Yang's actions warranted his eight-year ban, and will likely be career-ending.²²

Additionally, the United States Anti-Doping Agency (USADA) monitors American athletes. Congress created and funded the USADA in 2004.²³ The USADA monitors drug use and doping within competitions organized by the US Olympic Committee, including events that qualify American athletes to compete in the Olympics.²⁴ Also, American athletes are subject to blood testing at any time without advance notice by USADA, and failure to comply results in a ban from competition for a specified time.²⁵ Moreover, blood and urine samples taken from athletes can be preserved and saved for up to ten years for testing in later years.²⁶

The Olympic Committee attempts to promote fairness and sportsmanship within the Games. Drug use and blood doping have

¹⁷ See, e.g., *Hill v. Nat'l Collegiate Athletic Ass'n*, 865 P.2d 633, 659 (Cal. 1994).

¹⁸ *Chinese Swimmer Sun Yang Banned Again, to Miss Tokyo Olympics*, ESPN (June 22, 2021), https://www.espn.com/olympics/swimming/story/_/id/31686617/chinese-swimmer-sun-yang-banned-again-miss-tokyo-olympics.

¹⁹ Brakkton Booker, *Champion Chinese Swimmer Sun Yang Gets 8-Year Ban for Doping Violation*, NPR (Feb 28, 2020, 12:47 PM), <https://www.npr.org/2020/02/28/810331548/champion-chinese-swimmer-sun-yang-gets-8-year-ban-for-doping>.

²⁰ Braden Keith, *Vial of Sun Yang's Blood Allegedly Smashed with Hammer in Drug Test Altercation*, SWIM SWAM (Jan. 27, 2019), <https://swimswam.com/vial-of-sun-yangs-blood-allegedly-smashed-in-drug-test-altercation/>.

²¹ See Booker, *supra* note 19.

²² *Id.*

²³ See 21 U.S.C. § 2001.

²⁴ See USADA, *Testing*, U.S. ANTI-DOPING AGENCY (July 15, 2021), <https://www.usada.org/athletes/testing/>.

²⁵ *Id.*

²⁶ *Id.*

long been banned within the Olympics to prevent unfair competition between world-class athletes, allowing an athlete's hard work and talent to prevail over unnatural enhancement.²⁷ These policies allow athletes from all backgrounds and countries to compete with each other without the fear another athlete has an advantage because of their country or circumstances.²⁸

When the gene doping issue became apparent, WADA quickly banned the practice.²⁹ The Olympic Charter requires athlete compliance with the World Anti-Doping Code, which prohibits drug use, and blood and gene doping.³⁰ The ban on gene doping was originally instated in 2003 and has been in place since.

B. NCAA AND CONSENT TO TESTING FORMS

Like in the Olympics, the National Collegiate Athletic Association (NCAA), the organization that oversees Division 1 collegiate athletics, aims to promote fair competition.³¹ Policies preventing students from participating in certain unfair practices help even the playing field amongst students at different universities.³² Unlike the goals embodied in the Olympic Charter, the NCAA is concerned with athlete safety.³³ Bans on different substances and practices are in place to protect students from the consequences of non-medicinal use of pharmaceuticals, burnout, and substance abuse.

The NCAA may regulate athletes' actions and test for drugs and doping through a consent form which athletes are required to sign before they can participate in collegiate athletics.³⁴ Signing the consent form includes submitting to tests and complying with the NCAA policies prohibiting the certain drug use, prescription

²⁷ See *WADA Ethics Panel: Guiding Values in Sport and Anti-Doping*, WORLD ANTI-DOPING AGENCY (Oct. 2017), https://www.wada-ama.org/sites/default/files/resources/files/wada_ethicspanel_setofnorms_oct2017_en.pdf.

²⁸ See *id.*

²⁹ See *Gene Doping*, WORLD ANTI-DOPING AGENCY, <https://www.wada-ama.org/en/gene-doping> (last visited Aug. 15, 2020).

³⁰ See *World Anti-Doping Code*, *supra* note 15.

³¹ NAT'L COLLEGIATE ATHLETIC ASS'N, NCAA DRUG-TESTING PROGRAM 2021-22 (LaGwyn Durden ed., 2021), https://ncaaorg.s3.amazonaws.com/ssi/substance/2021-22/2021-22SSI_DrugTestingProgram.pdf.

³² See *id.*

³³ See *id.*

³⁴ Sarah Polcz & Anna Lewis, *Welcoming Prometheus: Experimental Support for Deregulating Gene Doping*, SSRN ELECTRONIC J. 8 (Jan. 2018), <https://www-cdn.law.stanford.edu/wp-content/uploads/2017/07/Welcoming-Prometheus-SSRN-id2971558.pdf>.

medications, blood doping, and gene doping.³⁵ The NCAA is a private organization with the bargaining power to subject athletes to test for banned substances.³⁶

Courts have determined that athletes' participation in collegiate athletics is a privilege, not a legal right.³⁷ Thus, the NCAA can require athletes adhere to certain rules and policies, including the drug testing policies in place.³⁸ Additionally, courts have held the agreements do not conflict with state or federal rights to privacy.³⁹ As a private organization, the NCAA does not infringe on an individual's right to privacy if an athlete's expectation of privacy is upheld by the organization.⁴⁰ By signing a consent form to submit to drug and doping testing, athletes lower their privacy expectation and acknowledge the typical privacy they could expect, concerning their medical history and genetic information, does not apply.⁴¹

Drug testing within the NCAA is coordinated and executed by Drug-Free Sport International (DFSI).⁴² If athletes test positive for performance-enhancing drugs (PEDs), they are automatically withheld from competition for one full year.⁴³ The athlete also loses a full year of athletic eligibility from participating in their sport in the NCAA.⁴⁴ If the athlete tests positive a second time, they lose all remaining eligibility.⁴⁵

If an athlete is selected for testing for banned substances, they are subject to the same consequences as if the test were positive.⁴⁶ Athletes can be subject to urinalysis testing with no notice and can be tested in their off-season from their sport.⁴⁷ Although there are

³⁵ Consent Form 20-1b, NCAA, NCAA Division I Drug-Testing Consent (2020-21), https://ncaaorg.s3.amazonaws.com/compliance/d1/2020-21D1Comp_Form20-1b-DrugTestingConsentBannedList.pdf.

³⁶ ADAM EPSTEIN, SPORTS LAW 179 (Cengage Learning, 1st ed., 2002).

³⁷ See, e.g., *Hill v. Nat'l Collegiate Athletic Ass'n*, 865 P.2d 633, 659 (Cal. 1994).

³⁸ *Id.* at 703.

³⁹ *Id.* at 658.

⁴⁰ See *id.*

⁴¹ See Epstein, *supra* note 36, at 164.

⁴² NAT'L COLLEGIATE ATHLETIC ASS'N, 2019-2020 NCAA YEAR-ROUND DRUG-TESTING SITE COORDINATOR MANUAL 3 (2019), https://ncaaorg.s3.amazonaws.com/ssi/substance/2019-20SS1_YearRoundSiteCoordinatorDrugTestManual.pdf.

⁴³ *Frequently Asked Questions*, *supra* note 2.

⁴⁴ *Id.*

⁴⁵ *Id.*

⁴⁶ *Id.*

⁴⁷ *Id.*

serious consequences for testing positive for banned substances, and gene doping is prohibited by the NCAA, the NCAA does not currently test for the use of gene doping.⁴⁸

In 2014, only a few years after the Olympic Committee and WADA banned gene doping use, the NCAA banned the practice as well.⁴⁹ The NCAA consent form required to participate in sports mandates compliance with the NCAA drug and doping policies.⁵⁰ These policies include submitting to tests and prohibiting certain drug use, prescription medications, blood doping, and gene doping.⁵¹

C. PROFESSIONAL LEAGUES AND COLLECTIVE BARGAINING AGREEMENTS

Professional athletic associations ban many of the same substances as WADA and the NCAA, but generally ban the substances several years later than other organizations.⁵² Most professional athletic associations legally enforce these bans through collective bargaining agreements (CBAs).⁵³ CBAs are encompassing contracts that are binding on teams and players.⁵⁴ Players agree to the CBA when they participate in the league.⁵⁵ CBAs may require continued monitoring of athletes during pre-season, in the regular season, and sometimes in the off-season.⁵⁶

⁴⁸ See *id.*

⁴⁹ Polcz & Lewis, *supra* note 34, at 8.

⁵⁰ See, e.g., *Hill v. Nat'l Collegiate Athletic Ass'n*, 865 P.2d 633, 640 (Cal. 1994); *Frequently Asked Questions*, *supra* note 2. Notably, the Supreme Court of California acknowledged that the consent forms that agree to drug testing policies are valid on the students, even though the NCAA is a monopoly with far greater bargaining power than any one student. *Hill*, 865 P.2d at 640.

⁵¹ *NCAA Banned Substances*, NCAA (July 6, 2021), <https://www.ncaa.org/2015-16-ncaa-banned-drugs>.

⁵² See, e.g., Len Pasquarelli, *NFL Adds Amphetamines to Banned Substances List*, ESPN (June 27, 2006), <https://www.espn.com/nfl/news/story?id=2501680>.

⁵³ See *id.*

⁵⁴ See, e.g., Mark M. Rabuano, Comment, *An Examination of Drug-Testing as a Mandatory Subject of Collective Bargaining in Major League Baseball*, 4 U. PA. J. LAB. & EMP. L. 439, 440 (2002).

⁵⁵ David M. Washutka, *Collective Bargaining Agreements in Professional Sports: The Proper Forum for Establishing Performance-Enhancing Drug Testing Policies*, 8 PEPP. DISP. RESOL. L. J. 147, 147-48 (2007).

⁵⁶ See Joshua Winneker, *It's Time to Blow the Whistle on Performance Enhancing Drugs*, 20 LEWIS & CLARK L. REV. 55, 67 (2016).

To make changes to the CBA, the party controlling the agreement must first determine if the change is for a mandatory or permissive subject.⁵⁷ Mandatory subjects must be bargained with by the union that represents players, and permissive subjects can be inserted into the CBA without bargaining.⁵⁸ For permissive subjects, the athletic association may still choose to bargain with players and the union.⁵⁹ Mandatory subjects typically have a direct impact on the association's relationship with the player, while permissive subjects have a more nuanced effect on the player-association relationship.⁶⁰ Clauses requiring drug testing and procedures for such are typically mandatory for bargaining with labor unions under the National Labor Relations Act.⁶¹ Legal scholars predict changes to drug testing and other bans for practices are likely also mandatory subjects.⁶²

Because bans on different substances and practices are probably mandatory subjects for creating a new CBA for athletic associations, players must agree to the changes for them to apply.⁶³ Historically, players and their unions have been hesitant to budge in bargaining with associations about drug testing policies because athletes want to avoid potential scandals if they are caught.⁶⁴ When negotiating, drug testing policies have been a major point of contention, and a bargaining chip players' unions hang on to, often conceding on other important provisions to prevent drug and substance testing from occurring.⁶⁵

Fan support is a major reason why unions cave when negotiating and allow provisions implementing bans of more stringent testing policies.⁶⁶ When fans do not think games are fair and speculate about drug use with no testing schemes in place, viewership and support dwindle.⁶⁷ Fans find it difficult to support

⁵⁷ Rabuano, *supra* note 54, at 440.

⁵⁸ *Id.* at 446.

⁵⁹ *Id.*

⁶⁰ *Id.* at 447.

⁶¹ *See id.* at 441.

⁶² *Id.* at 449-51.

⁶³ *Id.* at 446.

⁶⁴ *Id.* at 442.

⁶⁵ Wolfgang S. Weber, Comment, *Preserving Baseball's Integrity Through Proper Drug Testing: Time for the Major League Baseball Players Association to Let Go of Its Collective Bargaining Reins*, 85 U. COLO. L. REV. 267, 269 (2014), http://lawreview.colorado.edu/wp-content/uploads/2014/01/13.-85.1-Weber_Final-edited.pdf.

⁶⁶ *Id.* at 285-86.

⁶⁷ *See id.*

their favorite teams and players if they think games are not fairly won. As fans lose faith in the integrity of the sport, unions are more likely to allow testing policies.⁶⁸ Further, as fans speculate about drug use and game fairness, unions are more likely to allow some changes to drug policies.⁶⁹

Additionally, it may take bargaining in several subsequent CBAs for associations to convince players' unions to agree to changes.⁷⁰ Sometimes, drug testing policy changes are withheld to be used as bargaining chips for negotiating future CBAs, being used in the future as concessions to prevent other objectionable provisions from being included.⁷¹ Players' unions usually allow small changes in testing policies in return for additional player benefits, such as salary increases or performance-based player incentives.⁷²

While CBAs are typically the governing document for banned substances and actions, player contracts may also influence whether players must comply with different CBA provisions.⁷³ If a player's contract includes not having to undergo random drug testing, a later-changed CBA could not force compliance with random testing requirements.⁷⁴

In the mid-2000s, the MLB attempted to implement random testing for performance-enhancing drugs after pushback from players who opposed including testing in the CBA.⁷⁵ The MLB required players to consent to random testing with a provision in a standard annual form apart from the CBA.⁷⁶ The players' union for MLB players filed a grievance, arguing the CBA was the singular

⁶⁸ *See id.*

⁶⁹ *Id.* at 286.

⁷⁰ *See generally* Rabuano, *supra* note 54, at 278-79. A prominent example of this has been the MLB's attempts to prohibit PED drug use. While PED's are now banned in the MLB, the change came after decades of the MLB pushing the topic in negotiations for Collective Bargaining Agreements, even attempting to circumvent the CBA at times. *See* Zachary D. Rymer, *Full Timeline of MLB's Failed Attempts to Rid the Game of PEDs*, BLEACHER REPORT (June 10, 2013), <https://bleacherreport.com/articles/1667581-full-timeline-of-mlbs-failed-attempts-to-rid-the-game-of-peds>.

⁷¹ *See* Weber, *supra* note 65, at 265.

⁷² *Id.*

⁷³ *Id.* at 280.

⁷⁴ *Id.*

⁷⁵ *Id.* at 273-74.

⁷⁶ Rabuano, *supra* note 54, at 454-55.

document that could impose requirements on players.⁷⁷ The arbitrator who heard the grievance agreed implementing random testing for PED use was a mandatory subject for which the MLB was required to bargain with the player's union to include in the CBA.⁷⁸

While the Olympic Committee and the NCAA are focused on promoting fairness within competition, professional athletic associations additionally focus on professional athletes' health and well-being.⁷⁹ For example, the NFL's ban on substances aims to promote fairness in competition and also focuses on substance abuse treatment to encourage athletes' well-being.⁸⁰ Professional associations also ban substances because of the harmful side effects on the human body when used for enhancement, rather than therapeutic purposes.⁸¹

The World Anti-Doping Agency and NCAA banned the use of gene doping quickly after the concept became a potential issue, but American professional athletic associations have not prohibited the use of gene doping. Altering an athlete's genetic material and enhancing performance through gene doping is permitted in the NFL, NBA, MLB, NHL, and MLS associations. Below is an analysis of different athletic associations, which practices are banned, testing policies, and potential repercussions if athletes violate a ban.

1. NATIONAL FOOTBALL LEAGUE

The NFL prohibits using anabolic agents, anti-estrogen agents, masking agents, and stimulants.⁸² Additionally, players may not use some naturally occurring substance in the human body, such as human growth hormone (HGH), erythropoietin (EPO), and insulin growth factor (IGF-1).⁸³ Every player is tested at least once between the beginning of training camp and the first full week of preseason

⁷⁷ Major League Baseball Player Relations Comm. v. Major League Baseball Players' Ass'n, Decision No. 69, Gr. Mo. 86-1 at 9 (July 30, 1986).

⁷⁸ Rabuano, *supra* note 54, at 450.

⁷⁹ See, e.g., NAT'L FOOTBALL LEAGUE, POLICY ON PERFORMANCE-ENHANCING SUBSTANCES 1 (2018), <https://nflcommunications.com/Documents/2018%20Policies/2018%20Policy%20on%20Performance-Enhancing%20Substances%20-%20EXTERNAL.pdf> [hereinafter NFL POLICY].

⁸⁰ *Id.*

⁸¹ *Id.* at 1-2.

⁸² *Id.* at 18-22.

⁸³ *Id.*

games.⁸⁴ Players may also be tested up to six times in the off-season.⁸⁵ The NFL may take blood or urine samples, or both, from players in the course of testing.⁸⁶

In the NFL, players can be fined heavily or suspended from the league if they test positive for any prohibited drugs or are caught doping.⁸⁷ Suspensions prevent widespread use of PEDs, as teams could lose a large number of valuable players if they are caught encouraging PED use.⁸⁸ This inhibits a team's performance in games, which could anger both fans who pay to watch the game, as well as investors.⁸⁹ The NFL's CBA also prevents players from bargaining with a team to prevent any salary forfeiture in the case of a positive PED test.⁹⁰ The CBA requires a player to forfeit a portion of their salary for any games the player is suspended for PED use.⁹¹ However, NFL teams may not terminate a player for PED use.⁹²

There are also penalties for refusing to submit to a drug test. The first time a player refuses to submit to testing a fine penalty of up to \$25,000 under his player contract is imposed, assessed and the player will be placed into the reasonable cause testing program.⁹³ The second failure to submit to testing results in an additional fine

⁸⁴ Memorandum from John A. Lumbardo, Indep. Adm'r of the NFL Policy on Performance-Enhancing Substances on Annual Test for Performance-Enhancing Substances (July 2017), https://nflpaweb.blob.core.windows.net/media/Default/NFLPA/Annual%20Test%20Memo_2017.pdf.

⁸⁵ Memorandum from John A. Lumbardo, Indep. Adm'r of the NFL Policy on Performance-Enhancing Substances on Off Season Testing for Performance-Enhancing Substances (Jan. 2021), https://nflpaweb.blob.core.windows.net/website/Departments/Player-Affairs/Wellness/30_2021-NFL-Off-Season-Testing-Memo-PES-Policy.pdf.

⁸⁶ *Id.*

⁸⁷ See NFL POLICY, *supra* note 79, at 9, 16; see also Michael Schotthey, *Breaking Down How the NFL Substance Abuse Policy Works*, BLEACHER REPORT (Dec. 4, 2013), <https://bleacherreport.com/articles/1875478-breaking-down-how-the-nfl-substance-abuse-policy-works>.

⁸⁸ NFL POLICY, *supra* note 79, at 17.

⁸⁹ See Weber, *supra* note 65, at 286.

⁹⁰ Nat'l Football League & Nat'l Football League Players Ass'n, Collective Bargaining Agreement 14 (2020), https://nflpaweb.blob.core.windows.net/media/Default/NFLPA/CBA2020/NFLPA_CBA_March_5_2020.pdf.

⁹¹ *Id.*

⁹² *Id.* at 251.

⁹³ Wesley Keefer, *What is the NFL's PED Policy?*, SPORTSKEEDA (July 18, 2021), <https://www.sportskeeda.com/nfl/what-nfl-s-ped-policy>.

of two weeks' pay, and the third violation will cost the player a two-game suspension.⁹⁴

2. MAJOR LEAGUE BASEBALL

The current CBA baseball players have with the MLB only prevents players from using steroids, stimulants, diuretics, masking agents, and "drugs of abuse."⁹⁵ Drugs of abuse include cannabinoids, cocaine, LSD, opiates, MDMA, GHB, phencyclidine, and any other drug included in Schedules I and II of the Code of Federal Regulations' Schedule of Controlled Substances.⁹⁶ Performance-enhancing substances, like HGH, IGF-1, testosterone, and anti-estrogens, are included in the steroid category and are also prohibited.⁹⁷

Each player is tested for steroids when they arrive to spring training.⁹⁸ Additionally, players may be tested for steroid use throughout the season and during championships.⁹⁹ The MLB collects urine samples from their players for these tests.¹⁰⁰ Players are not randomly or routinely tested for drugs of abuse; instead, players are tested if there is reasonable cause to test for them.¹⁰¹

If players do test positive for performance-enhancing drugs, their first offence will result in an 80-game suspension without pay, and a second offence will result in a 162-game suspension without pay.¹⁰² A third offence will result in a lifetime ban from the MLB.¹⁰³ However, players may apply for reinstatement to the league after one year and may earn reinstatement after 2 years.¹⁰⁴ Only one player has ever been permanently banned from the MLB for steroid use.¹⁰⁵

⁹⁴ *Id.*

⁹⁵ MAJOR LEAGUE BASEBALL AND MAJOR LEAGUE BASEBALL PLAYERS ASS'N, MAJOR LEAGUE BASEBALL'S JOINT DRUG PREVENTION AND TREATMENT PROGRAM 8 (2015), <http://mlb.mlb.com/pa/pdf/prohibited-substances.pdf> [hereinafter MLB POLICY].

⁹⁶ *Id.* at 8-9.

⁹⁷ *Id.* at 9-10.

⁹⁸ *Id.* at 15.

⁹⁹ *See id.*

¹⁰⁰ *Id.*

¹⁰¹ *Id.* at 18-19.

¹⁰² *Id.* at 37.

¹⁰³ *Id.* at 38.

¹⁰⁴ *Id.*

¹⁰⁵ *See Adam Rubin, Jenrry Mejia First Player to Get Permanent Ban for 3rd Positive PED Test*, ESPN (Feb. 12, 2016),

The MLB mandates a slightly different approach when a player tests positive for stimulant use, first focusing on clinical treatment, and additional testing to ensure compliance with the clinical treatment.¹⁰⁶ Only after a second positive test will a player receive a 50-game suspension without pay.¹⁰⁷ A third positive test will result in a 100-game suspension without pay, and the fourth will earn a player a lifetime ban.¹⁰⁸

3. NATIONAL BASKETBALL ASSOCIATION

The NBA has also banned substances such as HGH, steroid and performance-enhancing drugs, testosterone, and diuretics.¹⁰⁹ The NBA also prohibits marijuana use and other drugs of abuse, including cocaine, MDMA, phencyclidine, ketamine, methamphetamine, LSD, and opiates.¹¹⁰

Within the NBA, players may be tested up to four times in a season, and up to two times during the off-season.¹¹¹ However, only 1,525 tests total may be run according to the CBA, which does average around three to four tests per player.¹¹²

The first positive test for PED's will result in a 25-game suspension, and a second positive test may result in a suspension up to 55 additional games.¹¹³ The third positive result for PED use will result in immediate dismissal from the NBA.¹¹⁴ Players may apply for eligibility to return after clinical treatment and zero positive tests for six months for rookies, and twelve months for veterans.¹¹⁵ Notably, refusing a test within the NBA is treated the same as a positive test.¹¹⁶

https://www.espn.com/mlb/story/_/id/14768114/jenrry-mejia-new-york-mets-suspended-permanently-mlb-third-positive-ped-test.

¹⁰⁶ MLB POLICY, *supra* note 95, at 38.

¹⁰⁷ *Id.* at 38, 45.

¹⁰⁸ *Id.*

¹⁰⁹ Nat'l Basketball Ass'n & Nat'l Basketball Players Ass'n, Collective Bargaining Agreement I-2-3 to -6 (July 1, 2017), <https://cosmic-s3.imgix.net/3c7a0a50-8e11-11e9-875d-3d44e94ae33f-2017-NBA-NBPA-Collective-Bargaining-Agreement.pdf> [hereinafter NBA CBA].

¹¹⁰ *Id.* at I-2-2.

¹¹¹ *Id.* at 433.

¹¹² See Warren Chu, Note, *WADA Time to Choose a Side: Reforming the Anti-Doping Policies in U.S. Sports Leagues While Preserving Players' Right to Collectively Bargain*, 44 COLUM. J. L. & ARTS 209, 217 (2021) (citing NBA CBA, *supra* note 109, at 433).

¹¹³ NBA CBA, *supra* note 109, at 441-42.

¹¹⁴ *Id.* at 442.

¹¹⁵ *Id.* at 446-47.

¹¹⁶ *Id.* at 429.

However, the NBA has stricter penalties for drugs of abuse. If a first-year player tests positive for a drug of abuse, they are banned from the NBA for a one-year term.¹¹⁷ Veteran players who test positive for drugs of abuse have their contracts canceled and will be immediately dismissed from their team.¹¹⁸ The NBA has instituted a moratorium on its random testing policies for marijuana use, which it has extend through the 2021-2022 season.¹¹⁹

4. NATIONAL HOCKEY LEAGUE

The NHL and players' unions generally defer to the substances that are banned by WADA when compiling their banned substances list.¹²⁰ Performance-enhancing drugs WADA bans are typically banned by the NHL soon thereafter.¹²¹ Performance-enhancing substances banned by WADA include anabolic agents, diuretics, masking agents, beta-2 agonists, peptide hormones, growth factors, and hormone modulators.¹²² The NFL also tests for drugs of abuse, but athletes are not penalized for a positive test.¹²³ Instead, if a league doctor determines drug levels are too high, the player is referred to substance abuse treatment (herein "treatment").¹²⁴

Hockey teams as a whole are subject to no-notice testing at least once during training camp, and at least once during the regular season.¹²⁵ Individual players are also tested on a randomized, no-notice basis during the regular season and playoffs.¹²⁶ During the off-season, players may be subject to more random, no-notice tests,

¹¹⁷ *Id.* at 434.

¹¹⁸ *Id.* at 435.

¹¹⁹ Tim Reynolds, *NBA Will Not Randomly Test Players for Marijuana Again This Season*, NBA (Oct. 6, 2021), <https://www.nba.com/news/nba-will-not-randomly-test-players-for-marijuana-again-this-season>.

¹²⁰ Nat'l Hockey League & Nat'l Hockey League Players' Ass'n, *Collective Bargaining Agreement* 188 (Feb. 15, 2013), <https://www.nhlpa.com/the-pa/cba> [hereinafter NHL CBA].

¹²¹ *See, e.g., Meldonium Added to NHL's List of Banned Substances*, ESPN (Aug. 31, 2016), https://www.espn.com/nhl/story/_/id/17430015/nhl-adds-meldonium-banned-substances-list.

¹²² WORLD ANTI-DOPING AGENCY, *WORLD ANTI-DOPING CODE INTERNATIONAL STANDARD PROHIBITED LIST 2021* 5-12 (2021), https://www.wada-ama.org/sites/default/files/resources/file/2021list_en.pdf.

¹²³ NHL CBA, *supra* note 120, at 189.

¹²⁴ *Id.*

¹²⁵ *Id.* at 190.

¹²⁶ *Id.*

but there is a total league-wide maximum of 60 off-season tests.¹²⁷ Refusal to comply with testing is considered a positive test.¹²⁸

The first positive test results in a 20-game suspension without pay, and automatic referral to the NHL's substance abuse and mental health program.¹²⁹ Referral to that program may result in mandatory substance abuse treatment.¹³⁰ A second positive test results in a 60-game suspension without pay, and additional referral to the substance abuse program.¹³¹ A third positive test would result in "permanent" suspension, but players may apply for readmission to the league after two years being banned.¹³²

II. GENE DOPING: WHAT IS IT, HOW DO WE KNOW WHEN IT HAPPENS, AND WHY DO WE CARE?

Gene doping is the use of gene-editing technology for purposes outside of medical treatment. With the help of the CRISPR-Cas-9 system, extra genes in the human genome may be inserted into cells. These genes code for substances that are already present in the body, and help the body produce higher than typical amounts of these substances, resulting in enhancements to the typical human ability. Gene doping may increase oxygen delivery to muscles, increase muscle mass or bone density, and more; the possibilities are nearly endless. With these enhancements come extreme risks to athletes that may participate in gene doping.

While most athletic associations prohibit certain drugs and blood doping, as they artificially enhance athletic performance, many associations have not addressed gene doping as they do with other enhancements. When gene doping emerged as a potential issue after the successful use of genetic manipulation, WADA added the manipulation of genetic material and cells to the list of prohibited practices for athlete eligibility in the 2003 Olympics.¹³³ This ban came before gene doping in humans was widely used.¹³⁴

Since the 2003 ban, scientists have become better equipped to predict the potential outcomes and consequences of gene doping. The following section will discuss the scientific framework for gene doping and some potential targets for doping. Additionally, this

¹²⁷ *Id.*

¹²⁸ *Id.* at 191.

¹²⁹ *Id.* at 191-92.

¹³⁰ *Id.*

¹³¹ *Id.* at 192.

¹³² *Id.*

¹³³ Kara Rogers, *Gene Doping*, BRITANNICA (Aug. 19, 2010), <https://www.britannica.com/science/gene-doping>.

¹³⁴ Polcz & Lewis, *supra* note 34, at 8.

section will cover how doping in different circumstances may affect athletes, and potentially their children in the future. This section will then explain the current methods of testing for gene doping and the potential gene doping consequences.

A. CRISPR-CAS9

WADA defines gene doping as “the non-therapeutic use of genes and genetic elements or cells, or both that have the capacity to enhance athletic performance.”¹³⁵ There is a long history of blood doping and drug use in both professional and international athletics, but gene doping is newer and the potential complications and threat of unfairness in competition is much larger compared to blood doping and drug use.¹³⁶

As life-science technology improves, new therapies have also been discovered for treating medical conditions relating to genetic defects.¹³⁷ However, when these therapies are used in people without the medical condition that the gene would treat, the gene enhances, rather than treats the individual.¹³⁸

The molecular basis of gene doping is similar to gene therapy.¹³⁹ In both, a gene the person does not possess naturally within their genome is introduced to a somatic cell to cause the production of a protein.¹⁴⁰ In gene therapy, this protein is the “normal” variant the patient does not possess.¹⁴¹ In gene doping, this could cause the athlete to either produce more of a protein than they already produce or produce a better protein than the protein their DNA is already coded to produce.¹⁴²

While there are other methods to introduce genes into a genome, the CRISPR-Cas9 system is the main mechanism used in gene doping and the same mechanism used in gene therapy.¹⁴³ The system’s components enter into cells via a viral capsid.¹⁴⁴ Cas9 is a protein naturally found in bacteria and was originally discovered in

¹³⁵ See Battery et al., *supra* note 3.

¹³⁶ See *id.*

¹³⁷ See *id.*

¹³⁸ *Id.*

¹³⁹ *Id.*

¹⁴⁰ *Id.*

¹⁴¹ *Id.*

¹⁴² *Id.*

¹⁴³ JOEL FAINTUCH & SALAMAO FAINTUCH, *PRECISION MEDICINE FOR INVESTIGATORS, PRACTITIONERS AND PROVIDERS* 59 (1st ed., Academic Press 2019).

¹⁴⁴ See, e.g., Christine L. Xu et al., *Viral Delivery Systems for CRISPR*, 11 *VIRUSES* 5 (Jan. 4, 2019).

E. Coli.¹⁴⁵ This protein's components are able to separate double-stranded DNA, and then break the links between the nucleotides in each chain forming DNA.¹⁴⁶ Cas9 is led to the correct portion of DNA by a sequence of RNA complementary to one of the strands of DNA.¹⁴⁷

In gene therapy and gene doping, scientists create the RNA sequence that leads Cas9 to break the correct DNA once the targeted gene is known.¹⁴⁸ Once Cas9 knows where to cut and separate the DNA, the RNA binds to the DNA and Cas9 will add in the additional DNA sequence that is connected to the RNA sequence.¹⁴⁹ This new DNA being inserted into the cell's genome, codes the gene the patient or athlete is adding to their genome.¹⁵⁰ After this new DNA is introduced, it is still bound to the RNA and the cell recognizes damage has occurred to the cell's DNA and begins to repair the damage.

When the cell thinks it is correcting its own DNA, it will add the complementary nucleotides to the new DNA to create a double-stranded sequence and connects the ends of the DNA that Cas9 split apart to the newly added DNA.¹⁵¹ The cell now has a newly added gene so the cell can target and use to create proteins to help the body perform a targeted function.¹⁵²

In addition to the gene for EPO, there are over 200 known "fitness genes" to help improve athletic performance.¹⁵³ Some of these genes have become frontrunners to improve performance and are therefore used in gene doping.¹⁵⁴ These genes can increase an athlete's muscle mass, skeletal size and density, endurance, or decrease pain sensitivity that might limit performance.¹⁵⁵ There is even the possibility to target the growth of a specific type of muscle fiber to tailor performance.¹⁵⁶ As genetic research progresses, there

¹⁴⁵ Yoshizumi Ishino, *History of CRISPR-Cas from Encounter with a Mysterious Repeated Sequence to Genome Editing Technology*, 200 J. MICROBIOLOGY 1, 1 (2018).

¹⁴⁶ FAINTUCH & FAINTUCH, *supra* note 143, at 60.

¹⁴⁷ *Id.*

¹⁴⁸ *Id.*

¹⁴⁹ *Id.*

¹⁵⁰ *See id.*

¹⁵¹ *See id.*

¹⁵² *Id.*

¹⁵³ *See* Battery et al., *supra* note 3.

¹⁵⁴ *Id.*

¹⁵⁵ *See* David Gould, *Gene Doping: Gene Delivery for Olympic Victory*, 62 BRITISH J. CLINICAL PHARMACOLOGY 292, 294 (2012).

¹⁵⁶ *See* Battery et al., *supra* note 3.

will be more possibilities in what can be altered to tailor performance for a specific sport or type of activity.

Currently, one of the most popular genes that is a target for doping encodes the gene leading to the production of erythropoietin (EPO).¹⁵⁷ EPO is a hormone mostly produced in the kidneys, but helps regulate the red blood cell production.¹⁵⁸ Red blood cells carry oxygen from the lungs to other tissues in the body.¹⁵⁹ Synthetic Recombinant EPO (rEPO) has been used therapeutically in patients with kidney failure who do not naturally produce enough EPO to help bring their EPO levels back to a normal range.¹⁶⁰

When rEPO is used in athletes who already have normal levels, the athlete is able to deliver more oxygen to their tissues, and therefore perform better for longer.¹⁶¹ This is especially useful for endurance athletes who participate in sports where oxygen delivery is a major limitation on performance.¹⁶² Estimations show that between 3-7% of the best athletes in endurance sports may be doping with rEPO.¹⁶³

Other likely targets for gene doping are genes that code for anabolic factors helping increase muscle mass.¹⁶⁴ For example, insulin-like growth factor (IGF-1) is important in regulating skeletal muscle mass, thus increasing quantities of IGF-1 could increase an athlete's strength.¹⁶⁵ Another potential target to increase strength and muscle mass is human growth hormone (HGH).¹⁶⁶

Genetic enhancement through gene doping is used in somatic cells that do not make more cells down the line that continue to replicate the gene long-term.¹⁶⁷ However, with technology constantly improving, it may soon be easier to alter stem cells or

¹⁵⁷ E. Brzeziańska et al., *Gene Doping in Sport – Perspectives and Risks*, 31 BIOLOGY SPORT 251, 252 (2014).

¹⁵⁸ See Gould, *supra* note 155, at 294.

¹⁵⁹ See Battery et al., *supra* note 3.

¹⁶⁰ *Id.*

¹⁶¹ *Id.*

¹⁶² See Gould, *supra* note 155, at 252.

¹⁶³ Randal L. Wilber, *Detection of DNA-Recombinant Human Epoetin-alfa as a Pharmacological Ergogenic Aid*, 32 SPORTS MED. 125, 125 (2002).

¹⁶⁴ See Battery et al., *supra* note 3.

¹⁶⁵ Ronald J. Trent & Bing Yu, *The Future of Genetic Research in Exercise Science and Sports Medicine*, 59 MED. SPORT SCI. 189 (2009).

¹⁶⁶ A. Fallahi et al., *Genetic Doping and Health Damages*, 40 IRAN J. PUB. HEALTH 1, 6 (Feb. 7, 2011).

¹⁶⁷ See Battery et al., *supra* note 3.

germline cells in athletes.¹⁶⁸ Altering stem cells would cause a long-term change in the genome, and cause the expression of the inserted gene for all the cells that the stem cell creates.¹⁶⁹ Germline editing would not cause a big change in the gene expression of the person receiving the gene alteration, but could affect their future children and give the next generation an athletic advantage.¹⁷⁰

B. HOW CAN WE DETECT GENE DOPING?

For the Olympics, testing for gene doping is new.¹⁷¹ For the 2016 Rio Olympics, WADA tested blood samples for evidence of gene doping for the EPO gene after the games ended.¹⁷² The motivation for testing for EPO is partially because it is the most common genetic alteration used by athletes, and also because it is currently the only addition for which there is a known test.¹⁷³

The natural gene coding the EPO protein contains four introns, which are DNA segments that do not contribute to the protein.¹⁷⁴ Artificial EPO genes are not likely to include introns in the gene, so segments of DNA coding for EPO and do not contain introns are likely a result of gene doping.¹⁷⁵ A comprehensive test for all gene doping is not currently known, but scientists are working to find new tests for commonly targeted genes.¹⁷⁶

In 2009, WADA implemented ABP to combat the threat of gene doping.¹⁷⁷ An athlete's ABP includes blood samples to help test for alterations to biological material.¹⁷⁸ The ABP system is currently used to test for blood doping and other doping methods that could enhance performance.¹⁷⁹

With the ABP, WADA aimed to achieve two goals. First, to create a way to test later for biological alterations when the

¹⁶⁸ See Sebastian Schleidgen et al., *Human Germline Editing in the Era of CRISPR-Cas: Risk and Uncertainty, Inter-Generational Responsibility, Therapeutic Legitimacy*, 21 BMC MED. ETHICS 2 (Sept. 11, 2020).

¹⁶⁹ See *id.* at 3.

¹⁷⁰ *Id.*

¹⁷¹ See Sarah Everts, *New Tests to Identify Gene Tampering in Olympic Athletes*, AMERICAN CHEMISTRY SOCIETY: IN CHEMISTRY (Oct. 10, 2016).

¹⁷² *Id.*

¹⁷³ *Id.*

¹⁷⁴ *Id.*

¹⁷⁵ *Id.*

¹⁷⁶ See Battery et al., *supra* note 3.

¹⁷⁷ See ATHLETE BIOLOGICAL PASSPORT, *supra* note 11, at 4.

¹⁷⁸ *Id.* at 9.

¹⁷⁹ *Id.*

technology to test for those changes did not yet exist. Second, to generally deter gene doping.¹⁸⁰ Using an athlete's former sample submissions to the ABP system, labs can test for differences in biological data attributed to gene doping.¹⁸¹

Another potential method to test for gene doping is to take an athlete's tissue biopsy and compare the proteins in the muscle to the athlete's baseline version.¹⁸² The tissue can also be surveyed for evidence of virus-like cells entering the human cells, which could show gene doping evidence because of the delivery system for CRISPR-Cas9.¹⁸³ Taking a tissue biopsy from an athlete is much more invasive than a blood draw, and is not a popular solution to test for evidence of gene doping.¹⁸⁴ This method is not currently being practiced.¹⁸⁵

C. CONSEQUENCES OF GENE DOPING

One of the main reasons professional athletic associations have banned blood doping and unnecessary pharmaceutical use is the danger to athletes.¹⁸⁶ Administering unnecessary treatment to anyone can cause extreme complications, and gene doping is no exception.¹⁸⁷ Experimental genetic treatments in medical patients have previously caused cancer, and increased expression of certain proteins can cause structural damage to the body.¹⁸⁸ Different enhancements are likely to cause a wide variety of unknown complications, but known complications of excess substances in the body are also likely to occur.

For example, excess levels of the EPO can cause increased blood viscosity, which prevents blood flow and can result in lower oxygenation levels to vital organs.¹⁸⁹ Other complications of high blood viscosity include abnormal bleeding from impaired blood platelet function and severe immune responses.¹⁹⁰

¹⁸⁰ *Id.* at 12.

¹⁸¹ *See id.* at 57-58.

¹⁸² *See* Battery et al., *supra* note 3.

¹⁸³ *Id.*

¹⁸⁴ *Id.*

¹⁸⁵ *Id.*

¹⁸⁶ *See, e.g.,* NFL POLICY, *supra* note 79, at 1.

¹⁸⁷ *See* Battery et al., *supra* note 3.

¹⁸⁸ *See* Fallahi et al., *supra* note 166.

¹⁸⁹ *See id.*; *see also* ALIX PEREZ ROGERS & MOLLY ESTES, HYPERVISCOSITY SYNDROME, STATPEARLS (database updated July 21, 2021).

¹⁹⁰ *See* Fallahi et al., *supra* note 166; *see also* ROGERS & ESTES, *supra* note 189.

Potential HGH or IGF-1 complications range from inconvenient to severe.¹⁹¹ Some milder side-effects of these enhancements are headache, nausea, vomiting, and visual changes.¹⁹² More severe consequences include insulin resistance, diabetes, elevated intracranial blood pressure, enlargement of the heart, and cancer.¹⁹³ Each complication comes with their own risk.

While the presence of cancer in gene doping instances is currently speculation, scientists predict cancer is a likely outcome of gene doping because it is a medicinal gene editing consequence.¹⁹⁴ In a gene therapy clinical trial for treating a deficiency for SCID-X1, a heritable disease that causes immune deficiencies, several children developed leukemia.¹⁹⁵ As mentioned above when discussing HGH and IGF-1, cancer is a common consequence of excess substances in the body.¹⁹⁶ With gene editing's unpredictability, athletes who participate in gene doping could develop different types of cancer.

III. SHOULD PROFESSIONAL ASSOCIATIONS WORK TO BAN GENE DOPING, AND WHAT ARE THE CONSEQUENCES IF GENE DOPING IS NOT BANNED?

Gene doping creates issues for both international and professional athletics. First, professional associations do not currently ban gene doping. With athlete safety goals in mind, these major athletic associations need to work with collective bargaining units to ban gene doping. Second, even where gene doping is banned, there is not enough regulation and testing to determine if gene doping is being used and competition is actually fair. To ensure competition is fair and athletes remain safe, gene passports and further regulation should be used to test for doping as new tests arrive.

If unsuccessful, professional athletic associations could face many consequences. Athletes may face medical complications from unnecessary changes to their DNA. Additionally, gene doping can cause additional injuries leading to shorter careers. Finally, the trade systems professional associations currently rely on may crumble because teams will be hesitant to take on athletes who may have

¹⁹¹ See Fallahi et al., *supra* note 166.

¹⁹² *Id.*

¹⁹³ See *id.*

¹⁹⁴ See generally Fallahi et al., *supra* note 166.

¹⁹⁵ Battery et al., *supra* note 3.

¹⁹⁶ See Fallahi et al., *supra* note 166.

shorter careers, or reluctant to trade athletes in whom they invest doping resources.

A. WHAT SHOULD PROFESSIONAL ASSOCIATIONS DO?

While WADA and the NCAA ban doping to ensure fair competition, athletic associations' main goal is to keep athletes safe and prevent harmful activity to gain a competitive advantage.¹⁹⁷ Both the WADA/NCAA objective and the professional association goals support banning gene doping. Although protecting athletes supports a doping ban, gene doping is not currently prohibited in the NFL, NBA, MLB, or NHL.¹⁹⁸

The professional athletic associations mentioned above should attempt to place bans on gene doping. First, the gene for EPO is currently the most common target for gene doping.¹⁹⁹ As previously shown, EPO is banned by many professional associations through their CBAs.²⁰⁰ Additionally, IGF-1 and HGH are also banned by most professional associations and are common targets for gene doping.²⁰¹ Artificial enhancement of these naturally occurring substances is already banned, showing that professional associations acknowledge the risk posed to athletes.

While gene doping does not directly insert more of the banned substance into the athlete, gene doping does similarly artificially inflate a given substance's quantities. Since common doping targets are already banned, professional associations should attempt to ban inflating levels of the substances by other means.

To ban gene doping, professional associations would need to include the bans in the CBAs that are negotiated with players' unions. Like drug use, gene doping is likely a mandatory subject for bargaining. Because banning gene doping would probably be mandatory, players and the players' unions must agree to the bans. Only when the players agree will a ban on gene doping be implemented and therefore binding on the players. Players would

¹⁹⁷ Sarah Everts, *supra* note 171.

¹⁹⁸ NFL POLICY, *supra* note 79, at 1; NBA CBA, *supra* note 109, at 441-42; MLB POLICY, *supra* note 95, at 3; NHL CBA, *supra* note 120, at 189.

¹⁹⁹ E. Brzezińska et al., *supra* note 157, at 253.

²⁰⁰ NFL POLICY, *supra* note 79, at 23; NBA CBA, *supra* note 109, at I-2-5; MLB POLICY, *supra* note 95, at 11; NHL CBA, *supra* note 120, at 189.

²⁰¹ NFL POLICY, *supra* note 79, at 22-23; NBA CBA, *supra* note 109, at I-2-3; MLB POLICY, *supra* note 95, at 10-11. See E. Brzezińska et al., *supra* note 157, at 253.

also have to agree to testing procedures and penalties if an athlete did produce a positive test.

Professional associations should immediately begin introducing bans on gene doping in negotiations for upcoming CBA updates. Naturally, players will be hesitant to agree to these terms, but potentially less so than typical bans on PEDs. Because societal knowledge of gene doping is less prevalent than PEDs and drugs of abuse, a scandal is less likely if an athlete tests positive for gene doping.

Professional associations are currently in the unique position to contract for a problem that is probably not yet widespread. As such, athletes will likely be less worried about testing positive for gene doping because gene doping is not yet a common practice; therefore, the athletes would be more likely to agree to restrictions or bans on gene doping than those pertaining to drug use of the PED and drugs of abuse variety.

Although athletes are less likely to push back on gene doping bans, successfully implementing such a ban would still require significant bargaining and resources. There are several strategies associations could take to persuade athletes to agree with a ban. First, the associations could offer better player benefits as an incentive they would “give up,” and the players would accommodate a gene doping ban in return.

Second, if associations were especially motivated, they could campaign with fans to garner support for a ban. While this may be a fear-mongering tactic showing the potential for unfair competition in games, educating the public on the potential and gene doping risks could put pressure on athletes to agree with the ban. If more fans knew about the potential for gene doping and competing teams gaining an advantage over their home team, viewership may drop and players would be dissuaded from gene doping, increasing the chance unions agreeing to a ban.

As previously mentioned, testing options for gene doping are currently minimal. To compensate, professional associations could also attempt to bargain for programs like the biological passport currently used for WADA.²⁰² Information could be stored, and data compared to previous samples to potentially show the presence of gene doping. This method could soften the blow of introducing a ban because tests producing a positive result may not occur for many years, while also discouraging the practice before it becomes prevalent.

²⁰² See *ATHLETE BIOLOGICAL PASSPORT*, *supra* note 11, at 4.

B. WHAT COULD HAPPEN IF GENE DOPING IS NOT BANNED? INCENTIVES TO BAN GENE DOPING.

One reason gene doping should be banned within professional associations is, if allowed, players may be forced to participate in gene doping to remain competitive. If one player begins to gene dope and other players cannot keep up, other players will follow suit to remain competitive. Eventually, we could see games where all teams and players are participating in gene doping, and no players are depending on natural talents and hard work to win. This would probably not be popular with fans, and associations should be afraid of declining fan support, and therefore declining profits, if this does occur. This additionally justifies any potential incentives associations may need to offer players' unions to pass a gene doping ban.

It is important for players to understand the potential gene doping risks, and how they are greater than the risks associated with PED, stimulant, or illegal drug use. If gene doping becomes prevalent and necessary to remain competitive, players would put their bodies at extreme risk, including cancer. Players would likely object to these risks, and band together to prevent themselves, their teammates, and future athlete generations from gene doping to become or remain competitive.

With this gene doping snowball effect, player burnout rates may increase, possibly resulting in even fewer players with long, successful careers. As previously shown, gene doping may cause complications and the excess use of the body's resources for non-necessary functions. Increased amounts of substances like EPO, IGF-1, and HGH can have significant consequences on athletes' bodies.²⁰³ With the complications from unnecessary medical treatments comes more stress on the body and shorter careers. As career lengths shorten and turnover rates increase, more athletes will be drafted into the league. With fewer veteran athletes who have honed their skill in professional athletics, and more rookies thrust into positions, teams may be less cohesive. Again, fans would likely have decreased interest in less competitive teams, which could lead to a vicious cycle resulting in even more gene doping.

A decline in current trading systems is another potential change to professional sports, should gene doping not be banned. While this would only take place far in the future, if gene doping is not banned, players may be encouraged to try gene doping to become faster and stronger, and to have more endurance. Teams could eventually be

²⁰³ See Fallahi et al., *supra* note 166.

motivated to offer gene doping to their athletes if the practice is not regulated. While unlikely, if teams with deep pockets begin to offer doping to their athletes, they may also begin to invest in research or license a gene patent that could enhance their athletes. With more investment in athletes, and fear other teams accessing the technology used by others, trades between teams would become less likely, and contracts between teams and players may be for longer time periods.

Overall, gene doping has the potential to harm athletes and the professional athletics industry. Associations have several motivations to ban gene doping due to the potential consequences with gene doping.

C. HOW CAN DIFFERENT ASSOCIATIONS IMPLEMENT TESTING FOR GENE DOPING?

The WADA currently only tests for EPO doping in Olympic athletes, and the NCAA does not actually test whether athletes are participating in any gene doping, even though gene doping is prohibited.²⁰⁴ As previously stated, EPO is currently the only gene doping mechanism tested for, despite the availability of nearly endless ways to edit the human genome to enhance performance.²⁰⁵ At a minimum, the NCAA should implement the same testing and recording system used by WADA in the Olympics. This could easily occur because the NCAA's ability to change consent to test forms and testing procedures. However, professional associations would have to implement these systems through their collective bargaining systems.

Despite current limitations on the ability to test for gene doping, scientists will eventually be able to trace different gene additions as we can with EPO. In the meantime, one step to help detect gene doping in the future is to keep records of players' genetic information that exists prior to gene doping. New studies have shown whole-genome sequencing prior to gene doping may help identify doping, even when a target transgene for the doping is unknown.²⁰⁶ This would not immediately show past doping evidence but will help detect future doping by comparing genome information over time may show changes that have occurred due to gene doping.²⁰⁷

²⁰⁴ Sarah Everts, *supra* note 171.

²⁰⁵ *Id.*

²⁰⁶ Teruaki Tozaki et al., *Detection of Non-Targeted Transgenes by Whole-Genome Resequencing for Gene-Doping Control*, 28 GENE THERAPY 199, 199-205 (2021).

²⁰⁷ *See id.*

While preemptively sequencing athletes' DNA is not an approved method for testing for gene doping in humans, it would be useful and would help detection in the future. While it would be a drastic measure, implementing a genome sequencing database for athletes could be effective to detect genetic manipulation without looking for a specific doping target. This method would be more all-encompassing for gene doping targets than other current testing methods.

However, storing athletes' genomic data raises additional privacy considerations. WADA already stores and tracks hematological data for athletes competing in the Olympics.²⁰⁸ Implementing a system storing genome data would be more controversial, but possible. As noted above, athletes must agree to their hematological data storage as part of their contractual consideration, gaining eligibility to compete in the Olympics. If a genome tracking system was implemented, it would also be a requirement for Olympic eligibility. This could be feasible for the NCAA to implement this kind of system as well.

The NCAA may change the requirements for collegiate eligibility in their banned practices and testing policies without athletes agreeing to the specific terms. If genome tracking was a requirement included in its policies, students would have to agree to participate. To combat some backlash for tracking athlete genome information, WADA and the NCAA could agree to keep athletes' personal information and sample identities anonymous until a positive result occurred, thus also keeping their genome information confidential.

Professional associations, on the other hand, would have a much more difficult time in implementing a system tracking genomic data. As with implementing a ban on gene doping in the first place, this would likely be a mandatory subject for bargaining the athletes would have to agree to. Because athletes are able to object to testing protocols before they are implemented, a system like this would probably not be passed or included in a CBA. Most professional athletic association CBAs already include confidentiality clauses surrounding drug testing, so including confidentiality provisions protecting genomic data from being shared could increase the likelihood a genomic data tracking system would be included in a future CBA.

Looking to the current banned substances and testing policies by professional associations, similar policies and penalties should be implemented for positive results for gene doping. Testing

²⁰⁸ See *ATHLETE BIOLOGICAL PASSPORT*, *supra* note 11.

policies for the major professional athletic associations include testing at the beginning of a season, throughout the season, and sometimes even testing in the off-season.

If a genome tracking system is implemented, DNA samples should similarly be routinely taken. This is especially important because like how drug use evidence will eventually leave a player's system, gene doping evidence will disappear when an altered cell dies. Only gene doping evidence in stem cells would be present indefinitely, and not all doping would likely occur in stem cells.

Additionally, similar, if not harsher, penalties should be implemented if athletes are caught gene doping. Professional associations often treat different classes of substances differently when doling out penalties. Considerations for the punishment severity include how destructive the substance is to the athlete and how likely the substance is to give the athlete an unfair advantage. As gene doping is both inherently dangerous and has the potential to result in extremely unfair advantages, the penalties for gene doping should be severe. These penalties should also take into consideration how long the effects of gene doping may enhance the athlete.

IV. CONCLUSION

Not only should professional associations be working to ban gene doping just as they have drug use and blood doping, but these associations, the WADA, and NCAA should also implement more drastic measures to prevent the use of, and encourage the testing for, gene doping. If further regulations and testing are not implemented, there is the possibility the current systems that athletic organizations rely on will fundamentally change.

WADA and the NCAA currently ban gene doping, but professional associations do not. WADA and the NCAA mostly ban substances and practices when they give athletes an unfair advantage. Professional associations also consider fairness when banning substances, but also focus on athlete safety. WADA is able to ban substances because athletes agree to terms to be eligible for Olympic participation, and the NCAA similarly requires athletes to sign consent to test forms for eligibility. However, professional associations operate under a collective bargaining agreement. While WADA and the NCAA can change policies and ban practices without prior athlete approval, professional associations must get players' unions to agree to bans and testing policies for them to be enforceable and implemented.

Professional associations should undoubtedly implement bans and testing practices for gene doping. To do so, the associations

should immediately begin introducing bans in CBA negotiations and offer incentives to pass these bans. If bans on gene doping do not occur, the associations could see unfair competition and higher burnout rates for players earlier in their careers. Further, WADA, the NCAA, and professional associations should all implement, or attempt to implement stricter testing policies to ensure no doping is taking place.