Anti-Doping Awareness in Sports

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Lecture -8

WADA- Prohibited Methods

Good morning friends, and welcome to the NPTEL Anti-Doping course. This is Week 2, Lecture 3, and I'm Professor Dobson Dominic. Today's lecture is on the World Anti-Doping Agency's prohibited methods.

In the second week, we have been looking into WADA's prohibited list. We have already examined substances prohibited in competition only. Today's lecture will focus specifically on the methods prohibited by WADA. This lecture will include an overview of what the prohibited methods are, the different categories of these methods, the side effects associated with them, the detection strategies used, and we will conclude with a summary.

There are three categories of prohibited methods. Method 1, or M1, is the manipulation of blood and blood components. Method 2, or M2, is chemical and physical manipulation. Method 3, or M3, is genetic or cellular doping.

Method M1 refers to the manipulation of blood and blood components, commonly referred to as blood doping. Blood doping may involve autologous, homologous, or heterologous transfusions — that is, from one's own body or from an external donor. According to M1.1, the administration or reintroduction of any quantity of autologous, homologous, or heterologous blood, or red blood cell (RBC) products of any origin into the circulatory system is prohibited, with one exception. The exception is when autologous blood transfusion is done through registered centers during procedures like plasmapheresis, where athletes donate blood, plasma, or plasma components. In such cases, if properly documented and done at a registered collection center, the transfusion is permitted. Otherwise, administration of whole blood or RBC products is entirely banned.

The purpose of blood doping is primarily to increase the red blood cell count to enhance the oxygen-carrying capacity of the blood. This provides a performance advantage, particularly for endurance athletes like runners, marathoners, and cyclists. However,

blood doping has significant side effects. The blood becomes thicker, increasing blood viscosity. There is an increased risk of clotting, hypertension, and vasoconstriction. Over time, the risk of long-term kidney dysfunction also increases. Furthermore, the risk of cardiac arrest, brain stroke, and pulmonary embolism is heightened with blood doping.

Manipulation under M1 can also involve the artificial enhancement of oxygen uptake, transport, or delivery. This includes the use of erythropoiesis-stimulating agents and other products such as perfluorochemicals, Efaproxiral, Voxelotor, and modified hemoglobin products. All of these are banned by WADA at all times. These substances aim to increase the athlete's oxygen-carrying capacity, which is critical for endurance sports. Erythropoietin (EPO) is one of the most commonly misused substances in this category. Another manipulation method involves intravascular tampering — any attempt to alter the properties or components of blood by chemical or physical means is banned.

Method M2 refers to chemical and physical manipulation. This includes tampering or attempting to tamper with doping control samples to alter their integrity and validity. Common techniques include sample substitution, where athletes replace their own urine or blood samples with those from another source. Another method is adulteration, for example, adding protease enzymes that degrade substances like EPO to avoid detection. All these forms of tampering are explicitly banned by WADA.

M2 also includes the use of intravenous (IV) infusions or injections that exceed a total volume of 100 milliliters within a 12-hour period, unless received as part of a legitimate medical procedure such as hospital treatment, blood transfusion, surgery, or clinical diagnostic investigation. Any IV infusions or injections outside of these medical necessities are considered forms of chemical manipulation. The side effects of such manipulations can be severe, especially when conducted without proper medical knowledge. Common complications include bladder infections, medically referred to as cystitis, and other disorders related to the urinary tract or systemic complications.

Method M3 deals with gene and cellular doping. This represents a more advanced form of doping where genetically modified cells or genes are used to enhance performance. Since 2008, WADA has identified this as a serious and emerging threat. Gene doping is defined as the non-therapeutic use of cells, genes, genetic elements, or gene expression modulation for the purpose of enhancing athletic performance. Detecting gene doping is complex and still evolving. It is not yet considered fully foolproof. Current detection methods are divided into direct and indirect categories.

Direct detection methods involve identifying the inserted vectors or genetic material. Common techniques include polymerase chain reaction (PCR) and Southern blotting. Indirect methods analyze transcriptomic or proteomic changes in the body, often through

immune response markers. These techniques include real-time PCR, microarrays, mass spectrometry, two-dimensional electrophoresis, ELISA testing, and Western blotting.

To detect and stay ahead of newer forms of gene and cellular doping, WADA employs forensic science-based techniques. This includes monitoring athletes both during and outside of competition using tools like the Athlete Biological Passport (ABP). Forensic methods help detect deviations in biological markers that may indicate doping, even if the exact substance is undetectable. WADA also employs artificial intelligence and blockchain technologies to ensure data integrity and enhance transparency in doping control. Genetic and epigenetic analyses are also being developed to uncover sophisticated or hidden forms of doping.

In conclusion, the World Anti-Doping Agency enforces strict guidelines to prohibit methods such as blood doping, chemical tampering, and gene or cellular doping. The evolution of detection strategies, including forensic methods and technological advancements like AI and blockchain, plays a vital role in combating doping. Continued education of athletes, coaches, and support staff remains crucial in upholding the values of fair play in sport.

The references for today's lecture include the World Anti-Doping Agency website, the WADA Code 2021, the UNESCO International Convention Against Doping in Sport, and the McLaren Report on Russian Doping. These resources provide a comprehensive understanding of WADA's prohibited methods.

Thank you for listening. Jai Hind.