

A Review on Doping in Elite Sport : Prevalence, Method, and Governance

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Abstract: *The global effort to maintain fair play in competitive sports faces continuous challenges from the misuse of performance-enhancing drugs (PEDs). This review summarizes recent developments and persistent analytical hurdles across several key classes of substances prohibited by the World Anti-Doping Agency (WADA). Anabolic Agents and Peptide Hormones continue to dominate adverse analytical findings. The review highlights the significant health risks, particularly cardiovascular damage, associated with Anabolic-Androgenic Steroids (AAS). For Erythropoietin (EPO), the challenge remains the unambiguous distinction between endogenous and exogenous forms, especially with the practice of evasive microdosing. Advancements in detecting Growth Hormone (GH) misuse have been achieved through the GH Isoform Differential Immunoassay, while the verification of Chorionic Gonadotropin (CG) now relies on robust mass spectrometry (MS) techniques to tackle complex isoforms. Hormone and Metabolic Modulators present dual challenges, as exemplified by formestane, which is both a natural metabolite and an exogenous doping agent. The analytical gap is being addressed by incorporating Isotope Ratio Mass Spectrometry (IRMS) and lowering reporting thresholds. Beta-2 Agonists, though therapeutic for asthma, carry an anabolic potential, necessitating strict controls and analysis of specific routes of administration to prevent abuse. Furthermore, the paper addresses substances used to mask doping, such as the plasma-expanding properties of Glycerol, a Diuretic and Masking Agent. The detection of Cannabinoids, specifically Δ^9 -tetrahydrocannabinol (THC), is focusing on THC-glucuronide as a reliable urinary marker for recent inhalation. Finally, the difficulty in interpreting findings for Glucocorticosteroids (GCs) stems from distinguishing between permitted localized administration and prohibited systemic use, suggesting a need for analysis of unique metabolic signatures. Collectively, these challenges underscore the necessity for continual improvement in anti-doping tests, specifically focusing on techniques that can reliably establish exogenous origin, detect repetitive microdosing, and accurately determine the route of administration to ensure a level playing field and uphold the 'true spirit of sportsmanship'.*

Keywords: WADA (World Anti-Doping Agency), Performance-Enhancing Drugs (PEDs), Anabolic-Androgenic Steroids (AAS), Erythropoietin (EPO), Microdosing, Adverse Analytical Finding (AAF), Isotope Ratio Mass Spectrometry (IRMS), GH Isoform Differential Immunoassay, Dietary Supplements (containing prohibited substances), Masking Agents (e.g., Glycerol), Beta-2 Agonists, Glucocorticosteroids (GCs), Prevalence of Doping (likely a "double-digit figure"), Analytical Hurdles, Athlete Biological Passport.

