AntiDop: Training Missions on Nutritional Supplements for Athletes Support Personnel to Support Anti-Doping

D2.1. State-of-the-Art on Fight Against Doping

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Abbreviations

AAS	Anabolic-Androgenic Steroids
ADEL	Anti-Doping Education and Learning of World Antidoping Agency
AI	Artificial Intelligence
ASP	Athlete Support Personnel
GADA	Global Anti-Doping Athlete Education Programme
ICT	Information and Communication Technologies
IOC	International Olympic Committee
LLM	Large Language Model
OVEP	Olympic Values Education Programme
PEDs	Performance-Enhancing Drugs
SCT	Social Cognitive Theory
SDCM	Sport Drug Control Model
SDT	Self-Determination Theory
TUE	Therapeutic Use Exemption
TPB	Theory of Planned Behavior
WADA	World Antidoping Agency
WADC	World Antidoping Code
UKAD	UK Anti-Doping

Executive Summary

This report presents a comprehensive overview of the current state of knowledge, practices, and challenges in the fight against doping in sports. As part of the AntiDop project, this deliverable serves as a foundational reference for future educational interventions and training materials.

D2.1 starts with a historical analysis of doping, tracing its roots from ancient rituals to modern competitive sport, and highlights the emergence of international regulatory bodies, particularly the World Anti-Doping Agency (WADA). It emphasizes the development of WADA's policies, notably the World Anti-Doping Code and a suite of International Standards, which ensure consistent global enforcement.

Focus is given on the role of Athlete Support Personnel (ASPs), including coaches, medical staff, and parents, in influencing athletes' decisions and ethical behavior. Research confirms that ASPs are often key agents in shaping athlete values, and thus, their education and engagement is critical in anti-doping efforts.

A detailed literature review identifies the psychological, motivational, and contextual determinants of doping behavior. Models such as the Theory of Planned Behavior and Self-Determination Theory are applied to explain how attitudes, norms, and motivation influence athletes' choices. Risk factors include performance pressure, low self-regulatory efficacy, and moral disengagement.

Later, the report reviews a wide array of anti-doping educational interventions at international and national levels, including WADA's ADEL platform, UKAD's Coach Clean, and programs like iRunClean, TARGET (serious game), and VIRAL (virtual reality training). These programs adopt a values-based, theory-driven, and technology-enhanced approach to foster long-term ethical behavior and awareness among athletes.

The document further details ICT tools and modern teaching methodologies (e.g., Problem-based Learning, flipped classrooms, Gamification, and peer-mentoring) that enhance the accessibility, personalization, and impact of anti-doping education. It recommends using LMS platforms (like Moodle, eClass, or Canvas), mobile apps (e.g., WADA's Athlete Central), webinars, and analytics dashboards to deliver scalable and adaptable training.

Finally, the report presents best practices for designing impactful anti-doping education, including theory-informed, age and role-appropriate interventions, the use of digital tools and game elements (Serious Games and gamification principles). Moreover, the co-creation with target groups to enhance relevance is mentioned as an optimal design approach with the inclusion of parents, coaches, and broader communities. Other important design trends to be included in the final educational contents and training missions include continuous evaluation and adaptation of the materials based on user's feedback.

These findings support the overall goals of the AntiDop project, guiding the development of training missions and educational tools focused on supplement use and ethical decision-making in sport. D2.1 will be used by WP2 and WP3 tasks as a guide for content co-design activities. The review of determinants of doping behavior provides a theoretical foundation for tailoring WP3 training content to address key psychological and contextual risk factors (e.g., moral disengagement, peer influence, low

self-regulatory efficacy). Benchmarking of educational tools and ICT platforms guides the selection of interactive and mobile-compatible technologies (e.g., LMS, serious games, microlearning apps) to be used in developing training missions. Identified gaps in ASP-specific education highlight the need for role-based and modular training content, which WP3 will co-design with ASPs to ensure contextual relevance and engagement.

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1. Introduction to doping

1.1. A short history of the doping phenomenon

The term "doping" has a multifaceted history, with various definitions evolving over time. Its origins can be traced back to South Africa, where the Kaffir tribe referred to a stimulating beverage used in religious ceremonies as "dop". This concoction, often containing natural extracts like caffeine and alcohol, was believed to enhance endurance during rituals. Similarly, Zulu warriors consumed a drink made from grape skins and kola nut to boost their stamina in battle (Conti, 2010). The term "dop" was later introduced to the English language by the Boers, Dutch settlers in South Africa, who used it to describe various stimulant beverages. By 1889, "doping" appeared in English dictionaries, initially associated with the administration of stimulants to racehorses to manipulate their performance. Over time, the definition expanded to encompass a wide range of substances used by athletes before and during competitions to enhance performance (Conti, 2010).

In antiquity, mechanisms intended to enhance physical performance, whether legitimately or inappropriately, seem to have existed. The implemented preparations were likely ineffective; however, the possibility of a placebo effect cannot be dismissed. During the third millennium B.C. in Mesopotamia, the opium poppy was extensively utilized by individuals for its euphoric properties, and it is presumed that the ancient Egyptians also employed opiates to enhance their physical capabilities. In the Americas, the Aztecs drank the hearts of their human sacrifices, believing this practice allowed them to absorb the strength and valor of others. They also ingested chemicals derived from cacti to bolster their endurance and mitigate tiredness. In ancient Greece, athletes reportedly consumed various meats or blood broth—a protein-rich diet akin to modern recommendations for elite athletes. They also ingested herbs and mushrooms before competitions to enhance physical strength and performance. Aristotle, in the 4th century BC, noted facial distortions in athletes, suggesting the use of certain substances that altered their appearance. Specifically, Olympic athletes underwent "anagkophagia" (compulsory feeding), a regimen dictated by their trainers (Conti, 2010; Singh, 2017). The phenomenon of doping persisted into the Roman era. Flavius Philostratus, in the 2nd century CE, emphasized the role of physicians in athlete preparation and mentioned cooks preparing bread with analgesic properties. There are records of mixtures used to increase the speed of horses in chariot races and substances consumed by gladiators to boost strength. This historical pursuit of victory at any cost led to the exploration of illicit methods to enhance athletic performance, a mindset that has transcended generations. Thus, the roots of doping extend deep into antiquity (Conti, 2010).

The first documented and reliable case of doping in modern sports dates back to the latter half of the 19th century, during a race in Amsterdam's canal in 1865. However, it was in the 1960s that the detection of substances became a significant concern for the International Olympic Committee (IOC), following the death of Danish cyclist Knud Enemark Jensen during the Rome Olympics (Moller, 2005). The first official anti-doping tests were conducted at the 1968 Mexico City Olympics (Kremenik et al., 2006; Schwellnus & Derman, 1999). In these early stages, the use of prohibited substances could significantly enhance performance if taken in sufficient quantities before or during competition.

In 1967, the IOC established the Medical Commission to organize and oversee the fight against doping. The first list of prohibited substances issued then included only narcotics and stimulants. Over time, additional substances such as synthetic anabolic steroids, testosterone, and caffeine were added. In 1988, blood doping tests were discontinued and replaced by diuretics and beta-blockers tests, with peptide hormones added a year later. Since 1993, beta-2 agonists have been considered doping agents (Schwellnus & Derman, 1999).

The period from the 1960s to the 1980s represented the pinnacle of anabolic steroid utilization in athletics. Upon discovering that the Russian weightlifting team's success was partially attributable to their utilization of testosterone, Dr. John B. Zeigler commenced experiments with Dianabol (methandrostenolone) on weightlifters at the York Barbell Club in 1958. The weightlifters transitioned to strength and conditioning coaches across several sports in the United States, facilitating the dissemination of anabolic steroids to other athletic disciplines, including American football. The German Democratic Republic implemented a state-sponsored anabolic steroid doping initiative that yielded numerous medals during the 1970s and 1980s, particularly for female athletes in swimming and track & field. The doping program and its health implications for women were thoroughly examined in a comprehensive assessment by Franke and Berendonk and featured in a television show by the Public Broadcasting Service. Ben Johnson of Canada tested positive for anabolic steroids in his urine during the 1988 Olympic Games in Seoul, resulting in the revocation of his gold medal. Although the initial objective of steroid use was to augment muscle development, since the late 1990s, their application in Olympic sports has predominantly shifted towards facilitating recovery, hence enabling more frequent and intensive training sessions. Testosterone significantly contributes to the greater red blood cell (RBC) mass in men compared to women, therefore providing advantages beyond its influence on muscular development. Other anabolic steroids exert a comparable influence on red blood cell formation (Bowers, 2012; Pope et al., 2014).

1.2. The role of WADA and national organizations

In 1999, the IOC acknowledged that successful combat against doping necessitated collaboration between sports and government entities. The IOC convened in Lausanne on February 4, 1999, following numerous doping scandals and athlete deaths due to substance use, and decided to establish the independent international organization WADA (World Anti-Doping Agency). Founded in November 1999, WADA aims to prevent and control the use of prohibited substances and methods. The inaugural World Conference on Doping in Sport led to the establishment of WADA in 2000, tasked with unifying global anti-doping initiatives. The World Anti-Doping Agency (WADA) has established a comprehensive World Anti-Doping Program, which has been embraced by all Olympic sports. To enable states to approve a counterpart to the World Anti-Doping Program, it was essential to formulate the International Convention Against Doping in Sport via the U.N. Educational, Scientific, and Cultural Organization (Bowers, 2012).

WADA was created to lead and coordinate international efforts against doping, receiving support from sports organizations and governments worldwide (van Bottenburg et al., 2021). One of WADA's primary contributions is the development and enforcement of the World Anti-Doping Code (WADC), which harmonizes anti-doping policies across sports and countries. The WADC provides a framework for anti-

doping rules, including the prohibited list of substances and methods, standardized testing procedures, and sanctions for violations (Houlihan, 2002). Beyond regulation, WADA emphasizes education and prevention, recognizing that effective anti-doping strategies require more than just testing and enforcement. The agency collaborates with national and international organizations to promote awareness about the dangers of doping and the importance of clean sport. WADA also invests in scientific research to stay ahead of emerging doping methods, such as gene doping, and to develop advanced detection techniques. This proactive approach ensures that anti-doping efforts evolve in tandem with advancements in performance-enhancing technologies (WADA, 2021a). In summary, WADA serves as the cornerstone of the international anti-doping movement, providing leadership, standardization, education, and research to uphold the integrity of sports worldwide.

WADA anti-doping regulations serve a triple purpose:
a) Protecting athletes' health: Safeguarding athletes from the negative consequences that can result from using prohibited substances and methods.

b) Ensuring fairness and equality: Preventing unfair enhancement of athletic performance, ensuring that athletes worldwide compete under the same conditions.

c) Upholding the spirit of sport and human dignity: Preserving the integrity and values inherent in sportsmanship.

The "spirit of sport" encompasses eleven core values that underpin and enrich sports, including: ethics, fair play and honesty; health; excellence in performance; character and education; fun and joy; teamwork; dedication and commitment; respect for rules and laws.

To better implement the Anti-Doping Code, WADA has formed national representations, the National Anti-Doping Organizations (NADOs). The establishment of NADOs has been instrumental in the fight against doping. Following doping scandals, such as the 1998 Tour de France incident, the creation of WADA in 1999 led to the formation of numerous independent NADOs worldwide. These organizations have become central to implementing international anti-doping policies at the national level (Kamber, 2011). They are responsible for implementing and enforcing anti-doping policies within their respective countries. Their key responsibilities include:

1. Adopting and implementing anti-doping rules: NADOs develop and enforce national anti-doping regulations that comply with the World Anti-Doping Code. This ensures a consistent and harmonized approach to doping control across all sports and countries.
2. Planning and implementing education programs: Education is a cornerstone of anti-doping efforts. NADOs design and deliver educational initiatives aimed at athletes, coaches, and support personnel to raise awareness about the dangers of doping and promote ethical sporting practices.
3. Conducting testing and investigations: NADOs oversee the collection of samples from athletes, both in-competition and out-of-competition, to detect prohibited substances and methods. They also conduct investigations into potential anti-doping rule violations, ensuring that any breaches are identified and addressed appropriately.
4. Managing results and adjudications: Upon identifying potential doping violations, NADOs manage the results, including the adjudication process. They ensure that due process is followed and that appropriate sanctions are applied in accordance with established regulations.

5. Collaborating with international and national bodies: NADOs work closely with WADA, international federations, and other national organizations to share information, strategies, and best practices. This collaboration enhances the effectiveness of global anti-doping efforts and ensures a unified approach to tackling doping in sport.

In summary, NADOs serve as the backbone of national anti-doping efforts, ensuring the integrity of sport through rule enforcement, education, testing, and collaboration (WADA, 2020).

1.3. Policies, standards and regulatory frameworks

The World Anti-Doping Agency (WADA) has established a comprehensive framework to combat doping in sports, centred around the World Anti-Doping Code (the Code). The Code serves as the foundational document that harmonizes anti-doping policies, rules, and regulations across sport organizations and public authorities worldwide. It is designed to ensure consistency and fairness in the detection, sanctioning, and prevention of doping (WADA, 2021b).

Complementing the Code are eight international standards, which provide detailed guidelines to ensure uniform implementation of anti-doping policies. These standards include (among others):

1. International Standard for Testing and Investigations (ISTI): This standard outlines mandatory protocols for test distribution planning, athlete notification, sample collection, and the transport of samples to laboratories. It also sets guidelines for gathering and utilizing anti-doping intelligence and conducting investigations into potential anti-doping rule violations (WADA 2021c).
2. International Standard for Laboratories (ISL): The ISL ensures that WADA-accredited laboratories produce valid and reliable test results. It promotes harmonization in analytical testing and establishes quality standards for laboratory practices (WADA. 2021d)
3. International Standard for Therapeutic Use Exemptions (ISTUE): This standard provides a framework for athletes to obtain permission to use prohibited substances or methods for legitimate medical conditions, ensuring that such exemptions are granted consistently and fairly (WADA, 2021e).
4. International Standard for Education (ISE): Establishes mandatory standards to support signatories in planning, implementing, monitoring, and evaluating effective education programs aimed at preventing doping in sport (WADA, 2021a).
5. International Standard Prohibited List (ISTI): Describes the substances that are prohibited in-competition and at all times (WADA, 2021f).

These documents collectively form the regulatory backbone of global anti-doping efforts, ensuring that all athletes are subject to the same rules and procedures, thereby upholding the integrity of sport. WADA also provides model rules, guidelines and protocols that can be used on (inter)national level for implementation of the anti-doping rules for NADOs, RADOs and (Inter)national federations in sport.

To ensure fairness, integrity, and athlete health in competitive sport, the World Anti-Doping Agency (WADA) has established a comprehensive framework of Anti-Doping Rule Violations (ADRVs) as outlined in the World Anti-Doping Code. These violations serve as the legal and ethical foundation for identifying and sanctioning doping-related behaviors. The following section presents a concise overview of the

eleven ADRVs currently in force, highlighting the range of actions and omissions that constitute a breach of anti-doping regulations. This categorization applies not only to athletes but also to support personnel such as coaches, medical staff, and administrators (WADA, 2021b).

1. Presence of a prohibited substance (Article 2.1). In this violation a banned substance (or its markers/metabolites) is found in the athlete's sample.

2. Use or attempted use (Article 2.2). In this violation the athlete uses or tries to use a prohibited substance or method, regardless of whether it was detected in testing.

3. Evading, refusing, or failing to submit to sample collection (Article 2.3). In this violation the athlete refuses, evades, or fails to provide a sample when required without a valid reason.

4. Whereabouts failures (Article 2.4). In this violation the athlete fails to file accurate whereabouts or misses scheduled tests three times in 12 months.

5. Tampering or attempted tampering (Article 2.5). This violation involves interference with any part of the doping control process (e.g., manipulating samples, providing false information).

6. Possession (Article 2.6). This violation involves possessing prohibited substances or methods, unless for a genuine medical reason with a Therapeutic Use Exemption (TUE).

7. Trafficking or attempted trafficking (Article 2.7). This violation involves selling, transporting, distributing, or attempting to distribute banned substances or methods.

8. Administration or attempted administration (Article 2.8). This violation involves giving, prescribing, or trying to give a prohibited substance or method to an athlete.

9. Complicity or attempted complicity (Article 2.9). This violation involves helping, encouraging, covering up, or being otherwise involved in an ADRV.

10. Prohibited association (Article 2.10). This violation involves working with coaches, trainers, doctors, or other personnel who are sanctioned for anti-doping violations.

11. Acts to discourage or retaliate against reporting (Article 2.11). This violation involves intimidating or retaliating against someone for reporting doping or cooperating with authorities (e.g., whistleblowers).

2. Risks/consequences of doping and the role of ASPs

2.1. Health, societal and economic coincidences of doping

Health consequences

Understanding the health consequences of performance-enhancing drug (PED) use is critical to evaluating the full impact of doping in sport. Doping's physiological and psychological ramifications pose serious risks to athlete well-being. A growing body of scientific evidence has documented the adverse effects of substances such as anabolic-androgenic steroids, growth hormone, erythropoietin, and other ergogenic agents. The following section presents a comprehensive summary of the key health risks associated with PED use, drawing primarily on the Endocrine Society's authoritative scientific statement by Pope et al. (2014), which synthesizes current research on the short- and long-term consequences across multiple organ systems. This evidence underscores the importance of preventive education and strict anti-doping regulation not only to uphold the integrity of sport but also to safeguard athletes' health.

The use of performance-enhancing drugs (PEDs), particularly anabolic-androgenic steroids (AAS), is associated with a broad spectrum of adverse health effects affecting multiple physiological systems. Cardiovascular complications are among the most serious and include hypertension, arrhythmias, atherosclerosis, and cardiomyopathy, all of which increase the risk of myocardial infarction, stroke, and sudden cardiac death. These outcomes are often exacerbated by the long-term and supraphysiologic dosing patterns observed in non-medical PED use. The endocrine system is also significantly disrupted, with users commonly experiencing hypogonadism, infertility, and hormonal imbalances, which may persist even after drug cessation. In adolescent users, PEDs can lead to premature closure of epiphyseal growth plates, resulting in stunted growth. Hepatotoxicity is another concern, particularly with orally administered steroids, which have been linked to cholestatic jaundice, hepatic tumors, and peliosis hepatis. Additionally, renal dysfunction, including focal segmental glomerulosclerosis and acute kidney injury, has been observed, especially in bodybuilders using high doses of AAS and other substances like diuretics and insulin.

Psychiatric effects are also prevalent and include mood disorders such as aggression, irritability, mania, depression, and increased suicidality. Some individuals may develop dependence on AAS, experiencing withdrawal symptoms that complicate cessation efforts. In men, reproductive side effects include testicular atrophy, reduced sperm production, and gynecomastia due to estrogen conversion. Women may experience virilization symptoms, including deepening of the voice, menstrual irregularities, clitoral enlargement, and hirsutism. Musculoskeletal injuries, especially tendon ruptures, can result from disproportionate muscle growth that exceeds tendon capacity. Dermatological issues such as severe acne, oily skin, and injection site infections are also commonly reported. These findings underscore the substantial and often underappreciated risks of PED use, which go beyond temporary performance enhancement to include lasting damage to physical and mental health (Pope et al., 2014).

Societal consequences

An underlying justification for anti-doping legislation is that doping undermines the public perception of sport, which consequently presents a significant threat and may yield grave repercussions for the sports sector and sport management organizations (Engelberg et al. 2012). A prison term resulting from an Anti-Doping Rule Violation (ADRV) should not be viewed merely as a legal or sports-related consequence for the individual; it also has implications for society and sport as a whole. Consequently, in addition to the repercussions associated with sports and legal matters, one must also consider the social ramifications at the person level, which encompass revenue loss that jeopardizes livelihood, as well as humiliation, social shame, and tarnished reputation (Dimeo & Møller 2018). The social implications, frequently undervalued, appear to exert a more significant deterrent effect than the previously described legal or sports-related repercussions (Huybers & Mazanov, 2012; Overbye et al. 2015). Consequently, they should be evaluated in light of the strict liability rule, which typically heightens the likelihood that an athlete, even without the intent to cheat or violate anti-doping regulations, may still encounter severe repercussions. In such instances, the strict liability rule may exert a "dehumanizing effect" (Dimeo & Møller 2018, p. 117) and can occasionally result in sadness or even suicide (Dimeo & Møller, 2018). At an organizational level, the societal repercussions should not be overlooked. The public perception of the sport is jeopardized by doping, and the ongoing coverage of doping incidents in nearly every significant sporting event may erode public backing for anti-doping legislation, which could be regarded as unreliable and ineffective. Consequently, Engelberg et al. (2012) conclude that policymakers must ensure anti-doping law has robust public support, which may prove to be a formidable challenge and presents significant risks for sports management organizations at all levels.

Financial consequences

Doping sanctions can lead to severe and long-lasting financial repercussions for athletes. These consequences extend far beyond temporary bans from competition and often result in significant losses of income, sponsorships, and career opportunities. First, athletes who are sanctioned typically forfeit any prize money, appearance fees, or medals won during the period in which they were found to have used prohibited substances (WADA, 2021b). For elite athletes, this may amount to millions of dollars. A prominent example is Lance Armstrong, who, following his lifetime ban and stripping of seven Tour de France titles, was forced to return over $10 million in bonuses and prize earnings and settled lawsuits exceeding $100 million in potential damages (USADA, 2012).

Second, athletes lose lucrative sponsorships and endorsement deals as sponsors seek to distance themselves from the reputational damage associated with doping. For example, sprinter Marion Jones lost endorsements with Nike, Reebok, and Gatorade, estimated at over $1 million per year, after admitting to steroid use, according to Wikipedia. In addition to lost income, athletes often face legal costs associated with appeals or litigation and may be required to pay fines or reimburse sports federations for damages, as seen in the case of Asafa Powell, who filed a lawsuit against his supplement provider after a doping ban cost him both competitive opportunities and earnings (Raynor, 2015).

Moreover, the long-term earning potential of a sanctioned athlete is compromised. Many lose opportunities to transition into coaching, broadcasting, or administrative roles, as doping tarnishes their

reputation and perceived integrity. Studies have shown that a doping conviction can reduce post-career employment prospects and access to institutional support (Overbye et al., 2015). For younger athletes or those in early career stages, sanctions may permanently end a professional sports career, nullifying the return on years of training investment. In summary, the financial toll of doping violations is often devastating and irreversible, involving direct economic penalties, indirect loss of reputation and career momentum, and exclusion from the broader professional sport ecosystem.

2.2. Athlete Support Services and relation to Doping

Athlete Support Personnel (ASP)—defined by WADA as *"any coach, trainer, manager, agent, team staff, official, medical or paramedical personnel, parent or any other person working with, treating, or assisting an athlete participating in or preparing for sports competition"*—hold a formal and ethical responsibility in the global fight against doping (WADA, 2021b). Under the World Anti-Doping Code, ASP are not only expected to support clean sport values but are also subject to anti-doping rules and sanctions if they are found to be complicit in any form of doping behavior, including administration, encouragement, or cover-up of doping practices.

According to Article 21.2 of the WADC, the core responsibilities of ASP include:

- Being informed about and complying with all anti-doping rules applicable to them and the athletes they work with.
- Using their influence to positively affect athletes' decisions about doping and performance-enhancing substances.
- Fostering an environment that actively discourages doping through ethical behavior, values-based communication, and adherence to safe training practices.
- Preventing the use of prohibited substances or methods, particularly among young or vulnerable athletes.
- Collaborating with NADOs and international federations by participating in testing, education programs, and anti-doping investigations when necessary.

NADOs further emphasize that ASP are integral to the educational efforts designed to prevent doping. Many national anti-doping education programs (e.g., UKAD's *Coach Clean*, Anti-Doping Norway's *Real Winner*) have dedicated modules for ASP to help them understand how their attitudes, communication, and behavior influence athlete decisions. WADA's International Standard for Education (ISE) also mandates the inclusion of ASP in tailored anti-doping education, recognizing that education should be developmentally appropriate and role-specific. Ultimately, ASP are seen as role models, mentors, and gatekeepers of ethical conduct in sport. Their proactive involvement in clean sport education and their resistance to doping pressures are essential to shaping a doping-free culture.

Athlete Support Personnel (ASP) play a pivotal role in shaping athletes' decisions, behaviors, and attitudes toward doping. Research shows that ASP influence operates through multiple psychological and social mechanisms, such as normative expectations, role modelling, emotional support, and informational control (Ntoumanis et al., 2014; Backhouse et al., 2016). Athletes often rely on ASP for guidance, especially during vulnerable moments such as injury, performance slumps, or transitions between competition levels. In this context, ASP can either act as a protective buffer against doping or

become unintended enablers, depending on their ethical stance, level of knowledge, and behavior (Barkoukis et al., 2019a). Coaches in particular have been shown to shape perceived norms and attitudes toward clean sport. When ASP promote performance-at-all-costs environments or implicitly condone the use of supplements or grey-area practices, they can increase athletes' susceptibility to doping (Nicholls et al., 2020). Conversely, supportive and ethically informed ASP who emphasize mastery, health, and fair play contribute to stronger anti-doping attitudes and higher self-efficacy to resist doping temptations (Boardley & Grix, 2014). Recognizing this influence, the World Anti-Doping Code explicitly includes ASP in its regulatory scope and holds them accountable for complicity or negligence in doping-related offenses (WADA, 2021b). Therefore, empowering ASP through targeted education, ethical leadership training, and involvement in values-based prevention programs is essential to cultivating a doping-free sport culture.

Athletes present unique challenges to medical professionals due to their strong emphasis on performance outcomes, which differs significantly from the priorities of the general population. While non-athletes typically focus on maintaining long-term health, minimizing discomfort, and preserving functionality throughout life, athletes are more often driven by goals related to athletic achievement. Their primary concern following injury or illness is often to recover quickly enough to resume training or competition. This performance-oriented mindset can lead some athletes to push beyond recommended rehabilitation guidelines. In such cases, it becomes the physician's responsibility to determine when it is safe for the athlete to return to specific activities. Physicians working with athletes or sports teams must remain aware of the ethical dimensions of their role and carefully evaluate the intentions behind clinical decisions.

For example, the College of Physicians and Surgeons of British Columbia emphasizes in its professional standards and guidelines that physicians treating athletes must act with caution when prescribing medications. Their foremost responsibility is to protect the health and well-being of their patients. They must remain alert to the risks associated with performance-enhancing drugs (PEDs), which are present at all levels of sport—from youth to elite competition. Physicians are expected to be knowledgeable about these substances and to educate athletes regarding their dangers.

Importantly, physicians must not prescribe, suggest, or facilitate access to substances or procedures aimed solely at enhancing performance. They are prohibited from administering or supporting the use of banned substances, and must not yield to pressure from athletes, coaches, or other parties. Staying informed about WADA's prohibited list and related anti-doping resources is essential. Physicians are expected to prescribe only those treatments that are medically justified and follow established clinical and ethical guidelines. They should also understand and comply with the Therapeutic Use Exemption (TUE) process, ensuring that all medications administered are essential for documented medical conditions.

The WADA Code outlines the obligations of athlete support personnel, which includes not only medical staff but also coaches, trainers, managers, and others directly involved in preparing athletes for competition. The Code recognizes the influence these individuals have and establishes accountability measures for those who are complicit in doping practices.

While much of the anti-doping focus has historically centered on professional ASP such as coaches, team doctors, and sport psychologists, it is increasingly evident that non-professional individuals also exert

substantial influence on athletes' decisions regarding supplement use. Parents and guardians, particularly in youth and developmental stages, often shape attitudes toward performance enhancement and health practices. Fitness influencers, who command large online followings, can inadvertently promote unsafe or banned supplements, especially when lacking anti-doping education. Instructors in recreational and amateur sport settings may serve as trusted figures but typically lack formal training in anti-doping ethics. Therefore, educational initiatives must account for these diverse ASP profiles by designing inclusive content that addresses their influence, provides actionable guidance, and ensures alignment with the broader goals of clean sport advocacy.

3. A literature review on anti-doping interventions

3.1. Determinants of doping behavior

Based on the meta-analyses by Ntoumanis et al. (2014, 2024) the determinants of doping behavior in sport span across psychological, motivational, social, and contextual domains. These determinants are best understood within the framework of well-established theories, such as the Theory of Planned Behavior (TPB), Self-Determination Theory (SDT), Social Cognitive Theory (SCT), and integrative models like the Integrative Model of Doping Behavior and the Sport Drug Control Model.

Among the most consistently reported predictors, attitudes toward doping and perceived behavioral control emerged as dominant, both directly influencing intentions to dope. These findings support TPB's assumption that doping behavior is intentional and rational, shaped by perceived outcomes and self-efficacy (Ntoumanis et al., 2014, 2024). Other significant predictors include moral disengagement, a mechanism that enables athletes to justify doping without moral conflict, and low self-regulatory efficacy, or the perceived inability to resist doping temptations under pressure (Boardley et al., 2015; Ring & Kavussanu, 2018).

Motivational variables have also been shown to play a critical role. Athletes driven by autonomous motivation and mastery goals (i.e., personal improvement) are less likely to endorse or engage in doping, whereas those operating under controlled motivation and performance goals (i.e., winning at all costs) are more vulnerable to doping behavior (Hardwick et al., 2022; Wang et al., 2020). Moreover, motivational climates, specifically those emphasizing task involvement versus ego involvement, can influence attitudes and intentions toward doping (Guo et al., 2021; Kavussanu et al., 2020a).

Furthermore, the perceived norms of important others (e.g., coaches, peers), anticipated regret, and situational temptation have been identified as contextual and emotional influences that modulate the decision-making process (Lazuras et al., 2010, 2017). Demographic variables, sport type, and supplement use also act as distal determinants, shaping more immediate attitudes and beliefs that precede doping behavior (Barkoukis et al., 2020; Hurst et al., 2019).

In conclusion, doping is not a behavior driven by a single factor but rather a complex interplay of individual values, motivations, social influences, and contextual pressures. Effective anti-doping interventions must therefore consider this multidimensionality and address both the psychological drivers (e.g., attitudes, motivations, morality) and the social-structural enablers (e.g., norms, availability, perceived effectiveness of alternatives).

3.2. Educational programs and raising awareness activities

Anti-doping interventions have become an integral component of global efforts to maintain the integrity and fairness of sports. These initiatives aim to prevent and deter doping use ensuring a level playing field for all competitors. Several interventions have been established over the years to combat doping in sports. Anti-doping interventions encompass a multi-faceted approach targeting numerous determinants of doping use. More specifically:

Doping regulations and testing programs: The World Anti-Doping Agency (WADA) has developed a comprehensive educational platform known as "ADEL" (Anti-Doping Education and Learning) to provide athletes and stakeholders with access to educational resources and courses. In addition to international efforts, many national and sport-specific organizations have their own educational programs. For instance, the United States Anti-Doping Agency (USADA) offers resources such as the 'TrueSport' program, and UKAD the '100% me' program which educates young athletes about the importance of values-based sports and anti-doping principles. Similarly, interventions such as SATURN (Goldberg et al., 2007) have investigated the effectiveness of the doping testing system.

Increasing awareness campaigns and programs: The WADA has understood the need to move from the practice of control and punishment to the creation of intervention actions to inform stakeholders about the use of prohibited substances. To this end, it has organised a series of educational actions such as (a) the YOUTH ZONE, which includes information on illicit substances and the reasons why they have been banned, (b) the Play True Generation Program, which includes the creation of information leaflets on the use of illicit substances and a short online game, c) ALPHA, which provides educational material on the consequences of doping and resistance to the doping dilemma; d) OUTREACH PROGRM, which is implemented in major competitions and includes individual sessions with athletes to inform them on issues related to doping, information material and question-and-answer games. Finally, WADA has created an information campaign with the general title SAY NO TO DOPING, aimed at sporting bodies and organisations. All these increase awareness activities have now been combined into a single educational programme aimed at athletes, coaches, parents, doctors and other support staff, covering a wide range of doping-related information (Anti-Doping e-Learning, ADeL).

In addition to these interventions, there are several other educational programs and tools developed by international and national organizations that contribute to the prevention of doping in sport. These initiatives are designed to support athletes, coaches, and other stakeholders in their understanding of clean sport values and decision-making regarding prohibited substances and practices. More specifically:

a) Olympic Values Education Programme (OVEP)

Implemented by the International Olympic Committee (IOC), OVEP is a global initiative that promotes the Olympic values of respect, excellence, and friendship. Although not exclusively focused on doping, OVEP plays a crucial preventive role by instilling a values-based culture in sport among children and youth. The program has been widely adopted in school curricula and youth sport development initiatives (International Olympic Committee, n.d.).

b) Speak Up! Platform

Developed by the WADA, this secure and anonymous whistleblower tool encourages athletes and support personnel to report suspicious doping activities. The Speak Up! platform also includes educational materials aimed at empowering individuals to recognize unethical behavior and to act in line with clean sport values (WADA, 2020).

c) iRunClean Education Program

An online anti-doping education tool created by European Athletics in partnership with WADA, iRunClean is tailored for athletes in track and field disciplines. The platform includes interactive modules on values-based decision-making and the risks of doping, and is mandatory for licensing in many European federations (European Athletics, n.d.).

d) Real Winner Platform

Developed by Anti-Doping Norway, this e-learning platform targets athletes, coaches, and support personnel. The interactive tool uses scenario-based learning to promote ethical awareness and decision-making in sport. It is widely used in Scandinavian countries and available in multiple languages (Anti-Doping Norway, n.d.).

e) Coach Clean

Created by UK Anti-Doping (UKAD), Coach Clean is an online course specifically designed to educate coaches on their roles and responsibilities in promoting clean sport. The program includes modules on ethical leadership, the doping control process, and how to support athletes in making informed choices (UKAD, n.d.).

f) Global Anti-Doping Athlete Education Programme (GADA)

Initiated by WADA, the GADA framework supports the development and harmonization of national anti-doping education strategies. It emphasizes long-term values-based education and offers resources for all stakeholders, including customized learning pathways for athletes at different stages of their careers (WADA, 2021a).

Educational interventions: Education programs are designed to inform athletes, coaches, and support personnel about the risks and consequences of doping, as well as the principles of clean sport. A number of educational programs have been developed such as Laure and Lecerf's (1999, 2002), the ATLAS and ATHENA programmes (Goldberg & Elliot, 2007) and Elbe and Brand's (2015) intervention through improved ethical reasoning. For more information on these programmes see Barkoukis (2015). At the same time, new programs are being created in an attempt to cover aspects of the phenomenon that were not covered by previous interventions in order to provide a more holistic and more comprehensive approach to how athletes should be educated to make the right decision when faced with the dilemma of doping. Such interventions include a) the Hercules program (Sagoe, et al., 2016) based on the appropriate framing of education in rational strength training without the use of doping substances, b) the intervention for education through literacy in the use of the internet and media (Galli et al., 2021; Mallia et al., 2020), and c) the implementation of specific seminars on ethics education in sport (Codella et al., 2019), or d) for school students (Barkoukis et al., 2016).

Next, some of the more recent educational and psychological interventions that have been developed to prevent doping are briefly presented:

a) The SAFEYOU intervention that addresses the growing need for education in the field of recreational sports. The self-education program aspires to be an effective intervention aimed at protecting young athletes and sportspeople from doping and includes strategies to prevent the use of doping substances, particularly by young athletes.

b) The SAFEYOU+ intervention that extended the existing SAFEYOU TOOL to athletes in competitive sports and to further develop a mobile phone application. The SAFEYOU+ intervention aims to promote the knowledge of young athletes on health issues. In addition, the educational material aims to develop the cognitive skills that underpin athletes' motivation and ability to succeed in competitive sport, and to help them understand and use in their everyday practice the ways in which self-care for health and well-being is promoted throughout their lives (Barkoukis et al., 2022).

c) Coaches Education on Sport Integrity which involves educational material that aims to: a) educate coaches in the recognition of illegal, unethical and immoral behaviour in sport; b) provide coaches with an ethical framework of ethical actions to address the causes, and the harmful consequences of these practices and the harmful consequences of corruption in sport; c) to provide coaches with the appropriate knowledge, competencies and skills to effectively manage threats to the integrity of sport, especially from doping, match manipulation and good governance; d) help coaches to create a climate in their teams that fosters a sporting culture that promotes meritocracy, transparency and integrity; e) combine theory with daily practice, and apply best practices; and f) provide coaches with the opportunity to receive high quality training on integrity in sport; and g) provide coaches with the opportunity to receive high quality training on integrity in sport.

d) A serious game (TARGET) against doping that addresses the fact that many athletes are reluctant to take the time to follow a doping education program if at that particular time they are not considering the possibility of using doping substances in order to improve their performance. However, when faced with the dilemma of using these substances, these athletes do not have the right information, information and education to make the appropriate decision. The TARGET is a serious game that aims to contribute to the fight against doping by providing a modern and innovative way through which it is expected to reach a wider audience than those involved in typical anti-doping education campaigns. The educational serious game includes pedagogical scenarios that incorporate flow charts, user feedback, prizes, badges and the game's rating system (Barkoukis et al., 2019b).

e) A virtual reality program (VIRAL) against doping that similar to TARGET aims to utilize new technologies to educate athletes and help them make informed decisions with respect to doping (Barkoukis et al., 2021). Developed within a European framework, the VIRAL project leverages virtual reality (VR) to create realistic, emotionally engaging doping-related scenarios that simulate real-life pressures and ethical dilemmas athletes may encounter. By allowing participants to make choices in a controlled but immersive environment, the intervention targets key psychological constructs such as moral disengagement, self-regulatory efficacy, anticipated regret, and normative beliefs—all of which have been identified as significant predictors of doping intentions and behavior (Ntoumanis et al., 2014; 2024). The VR-based experience encourages athletes to reflect on their values, understand the social and psychological costs of doping, and develop the confidence and skills to resist pressure. Importantly, this values-based and emotionally resonant approach marks a departure from traditional didactic anti-doping education, which often focuses narrowly on rules and sanctions. Instead, VIRAL adopts a preventive and developmental model, aligning with WADA's International Standard for Education, which calls for interventions that are age-appropriate, developmentally relevant, and theory-informed. Preliminary findings from the VIRAL intervention suggest improvements in athletes' decision-making confidence, moral reasoning, and resistance to social pressure, highlighting its promise as a scalable tool for shaping doping-resistant identities in sport.

f) Education on doping in recreational sport (DELTS programme) that includes two online courses. One is aimed at health professionals (e.g., doctors, psychologists, etc.) and the second at sports professionals (e.g., coaches, personal trainers, fitness and physical fitness coaches). More specifically, the course includes sessions providing information on the side effects of doping and the key variables associated with the decision to take doping substances (Barkoukis et al., 2022).

g) Education against doping in football (ANTI-DIF programme) addresses the issue of doping education for football players. The program involves eight animated videos on the health consequences of doping, resistance to social pressure to use doping substances, body image stereotypes, body image disorders and the control of supplements and pharmaceuticals (Skoufa et al., 2022).

h) Training of coaches in the fight against doping (CoachMADE programme) that aims to develop an educational material for coaches to help them to develop and use an appropriate motivational and interactional climate with their athletes, particularly when communicating on doping-related issues. The intervention programme consists of two seminars that focus on the increased need for the creation of supportive communication strategies that coaches could implement when interacting with their athletes in general and on doping-related issues in particular (e.g., testing for prohibited substances in medicines) (Ntoumanis et al., 2021).

i) Moral disengagement and self-efficacy interventions (HEROES and VIRTUE programmes) that consist of two intervention modules, each consisting of six sessions. The first intervention module consists of a formal information intervention on doping issues, such as the bodies organising anti-doping actions, the World Anti-Doping Agency's anti-doping code, the list of prohibited substances, doping control procedures, the health consequences of doping, the role of nutritional supplements and sports nutrition in performance in general, and relevant material on reporting irregularities in sport. The second intervention deals with the issues of training in moral disengagement and increasing self-efficacy (Kavussanu et al., 2020b, 2022).

j) The ADVICE intervention seeks to offer coach education programs targeted at grassroots coaches. The smartphone application known as ADVICE has been developed with the aim of facilitating coaches in their contemplation of various scenarios they may come across, ultimately working towards the objective of mitigating the occurrence of doping among young athletes participating in grassroots sports. The application comprises various essential modules that encompass subjects such 'fair play', 'substances', 'supplements', 'rules', and 'support' (Nicholls et al., 2020a).

k) The iPlayClean intervention aims to engage participants through the use of thought-provoking information, films, and interactive questioning techniques. The objective of this intervention is to disseminate information to elite athletes aged 14 to 18, as well as their respective coaches and parents. The focus of iPlayClean revolves around the subject matter of performance and provides a range of tactics aimed at assisting athletes in making informed choices when engaging in sports activities by comprehending use of nutritional supplements, and their exploration of the misconceptions around doping. The material also includes a parent and coach component (Nicholls et al., 2020b).

3.3. Used ICT tools and teaching methodologies

The fight against doping in sport continues to evolve, and thus the same has to be done in the educational strategies employed to prevent it. Education has been recognized as a key pillar in the World Anti-Doping Code (WADA, 2021), which emphasizes proactive approaches aimed at shaping values, increasing awareness, and equipping athletes and stakeholders with the knowledge and skills to make ethical decisions. Within this context, ICT tools and innovative teaching methodologies are essential instruments for delivering impactful, scalable and engaging anti-doping education. Actually,

previous research has highlighted the influence that education has on anti-doping rule violations. More specifically, it is supported that education is a structural factor of the 'dopogenic environment' that has a great influence on affected populations (Backhouse et al., 2016).

In the following sections, modern ICT tools applied in education and contemporary teaching and learning methodologies will be analyzed, in order to investigate the optimal approaches for the AntiDop learning solution.

3.3.1. ICT tools in anti-doping education

ICT tools used in education

Learning Management Systems (LMS) such as Moodle, Canvas, eClass and Google Classroom are widely used in formal and non-formal education settings to structure course materials, distribute content, monitor progress, and assess learning outcomes. These systems mostly support asynchronous eLearning or blended learning (or mixed learning) models and can host modules developed by organizations such as WADA Generally speaking, LMS platforms offer greater accessibility and continuity to its users and also support self-paced and context-specific education (Boardley et al., 2021).

Most eLearning solutions were developed using such tools, especially open-source LMS systems which support self-paced learning, modular course structures, quizzes, videos, discussion boards, user engagement monitoring and more. Moreover, they are equipped with a certification and learning progress tracking mechanisms. These specifications allow educational organizations to deliver role-specific courses (e.g., for athletes, ASP, educators) in multiple languages. In addition, LMS systems are hosted in cloud infrastructures, allowing global access, scalability, performance optimization and secure data storage (GDPR compliant).

Modern solutions are fully mobile responsive, enabling access via both desktop/laptops through web-browsers and devices like smartphones and tablets using browser-based interfaces. Native apps are rarely found due to the great diversity of devices and operating systems.

Built-in dashboards and analytics platforms (via Open edX, or Google Analytics) help educators/content developers to monitor the overall user engagement and course completion rates. Personal data are protected using standard user authentication and data security mechanisms. Single Sign-On (SSO) systems and secure login features are some of them. Moreover, there is compliance with data privacy laws and regulations, including GDPR.

Other contemporary ICT technologies used in education (Educational Technology trends) involve various interactive e-learning modules created by third-party ICT tools which export files in SCORM/xAPI-based content. A few examples involve interactive concept maps, self-evaluation quizzes, interactive images enhanced with hot areas, mini-games like crosswords with terminology, interactive digital narrations, video-demonstrations, hypervideo installations (audience-driven videos) and more. These modules are being created by toolsets for teachers and content developers like Articulate Storyline, Adobe Captivate, MIT App Inventor, video-editors, game engines like Unity and other web-based tools.

An interesting educational design trend are podcasts and audio lessons. Especially useful for mobile learning and auditory learners, this kind of EduTech solution offers flexible and accessible ways for learners to engage with content, especially in mobile or multitasking environments. There is enough

evidence that this may become more popular during walking, cooking or even during long-driving sessions (Wolpaw et al., 2022; Salas & Moller, 2015), as they can fit into short breaks or flexible daily routines (see micro-learning model explained later).

Podcasts are series of audio recordings, usually focused on a specific theme or subject. They rely on audio, but can have video of the speakers as well. They can be episodic, often featuring interviews, expert discussions, or narrative storytelling. Educational podcasts may cover topics such as language, science or professional development.

On the other hand, audio lessons include structured audio-only learning content, which is often shorter and more instructional than podcasts. They are designed specifically for step-by-step teaching, such as language drills and audiobook-style narration of lessons. Audio lessons and podcasts often encourage deeper thought without visual distraction, makes the educational material more accessible and easily distributable across platforms (e.g., Spotify, Apple Podcasts, LMS, etc.)

Synchronous lessons are based on live webinars (or even virtual classrooms) using communication and collaboration platforms like Zoom, or MS Teams. They allow real-time interaction, polls, and breakout rooms. But it is quite common to re-use recordings of webinars and podcasts for asynchronous courses as well. All those static media solutions may not be ideal for visual learners or subjects requiring diagrams, formulas, or interaction and they offer relatively limited immediate feedback (unless combined with interactive quizzes, or follow-up activities). Moreover, they require good scripting and sound quality for effectiveness. These tools became increasingly relevant during the COVID-19 pandemic and have remained key for remote outreach and international cooperation (Kornbeck, 2020).

At this point the most advantageous ICT solutions appear to be Adaptive Learning Systems, which are AI-based platforms that personalize learning paths according to learner's personal profile or Persona (e.g., Smart Sparrow, Knewton). Adaptations can take effect both on educational material and on learning paths. In the first case, the educational material can be adapted to the learning rhythm of the student, can be filtered according to her learning objectives, or can adapt the used language and used media (dynamic adaptation of the perceived level of learning difficulty). In the second case, the learning platform can propose different learning routes to the student (alternative reading material, non-linear consumption of the learning material, etc.).

Another advanced ICT tool is simulations used in education. Simulations can be powerful instructional tools that replicate real-world processes, environments, or scenarios in a controlled, often interactive, setting. They allow learners to apply theoretical knowledge, safely experiment with various scenarios. Learners can develop critical thinking and problem-solving skills through active engagement with simulators. Quite often, these simulators appear like virtual labs used to simulate scientific, or technical experiments, or even support role-playing and social simulation (e.g., PhET simulations, Labster, SimCityEDU). Some simulators are immersive leading to virtual reality (or mixed reality) experiences.

A current and increasingly popular educational design trend is serious games and gamification. Although most researchers and educators think that they are not the same thing, both approaches introduce game elements in educational settings. They are powerful approaches in education as they can motivate learners, increase the time learners spend on educational material, provide extra motivation for engagement, and improve learning outcomes.

Serious games are being used as full-fledged games, but with clear learning objectives embedded into their structure. An excellent example of a serious game used for antidoping education is TARGET (Chaldogeridis et al., 2021). It's about a serious game developed to educate adolescents about the risks and ethical considerations of doping in sports by promoting clean sport behaviors using a simulator of real-life scenarios, where players make decisions that influence the game's outcome. In cases, the game elements and a reward system are inserted into the overall learning experience. The outcome is a gamified learning environment, i.e. gamification. Additional elements like infographics, animations, and real-life stories enhance emotional engagement and information retention. Gamified platforms such as Kahoot! and Quizizz are used to create interactive quizzes that transform passive learning into active participation (Barakat et al., 2020). There are a wide range of gamification solutions, most are custom-made, or are based on gamification engines like Mambo.io which gamify all kinds of web activities (in an educational website), or Classcraft which can gamify classroom management and learning.

Last but not least, there is the use of artificial intelligence (AI). AI is rapidly transforming education by enabling personalized learning, automation, intelligent tutoring, and data-driven decision-making. It's being integrated through various ICT tools and platforms that support both teaching and learning. It entails the use of Large Language Models (LLMs) to interact with learners in natural language in question-and-answer sessions (mostly known as ChatBots, or AI tutors), or using machine learning algorithms, natural language processing, and automation technologies to enhance learning experiences, support educators, and streamline administrative tasks.

Existing solutions in anti-doping education

The existing educational interventions already contain a rich and diverse list of educational material formats, covering **static**, **interactive**, **visual**, and **experiential** modalities. Table 1 presents a benchmarking on the ICT technologies and educational content formats already found during the desk research of D2.1.

WADA is the most prominent organization providing education and information on doping rules and processes. WADA offers educational programs for athletes, organized in courses. The International-Level Athletes course was evaluated in this study[1]. It provides asynchronous learning material in form of a profile-protected webpage with interactive navigation to the table of contents with clues, short text and bullet point lists. There are kinds of interactive pictures, but they are decorative to the text. No other interactive educational material or videos were found. At the end of the course there is an interactive online quiz used to test the knowledge of the learner and provide a certification.

USADA uses athletes' guides in pdf format[2] and some webpages (mostly static[3]) to deliver its educational material to athletes. This documentation contains high quality educational and informative

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[1] WADA educational material, available at: https://adel.wada-ama.org/learn/learning-plans/1/international-level-athletes-education-program-english/courses/9/adel-for-international-level-athletes-english/lessons/110:1207/welcome-to-clean-sport

[2] USADA downloadable educational material in pdf like Clean Sport Handbook, available at: https://www.usada.org/wp-content/uploads/2025-Clean-Sport-Handbook.pdf

material in eBook format. Some additional videos[4] have been released through their website and are being used as introduction to main concepts. The USADA education covers topics like anti-doping, supplements, medicines and medical care, and testing processes.

The Greek National Anti-Doping Organisation (HADA) leverages education as a key tool to promote the concept of substance-free sport. HADA conducts a variety of initiatives, including training seminars for athletes, journalists, students, and educators. Additionally, it develops educational materials that are made available through the agency's official website and social media platforms. It is worth to note that parts of the educational content are translations from WADA.

GLDF4CleanSport is an Erasmus+ project which aims to uphold the integrity and core values of sport by addressing the fight against doping. Its ultimate goal is to enhance the effectiveness and quality of work performed by key professionals, thereby strengthening the impact of the organizations they represent. As part of its outputs, GLDF4CleanSport has published a long list of good quality educational material (but non-interactive), which can be accessed online[5].

There are a lot more organizations and EU-funded projects which offer education on anti-doping, but this list of educational resources is only a representative sample of the material available.

The European Athletics Federation has released the eLearning platform "I RUN CLEAN"[6]. This is an online platform to be used by athletes, coaches, judges and other interested parties to gain access to a wide range of training content related to athletics. There are 9 lessons and one quiz at the end in the form of interactive hints and videos.

The European Athletics Federation uses the same back-end platform and the same educational material as World Athletics, thus the results of the benchmarking are identical.

While these platforms provide valuable resources on anti-doping, much of the educational material they offer tends to follow a more traditional or outdated format. This includes static presentations, long-form PDFs, and non-interactive modules, which may limit engagement—especially among younger or more digitally native audiences. There are some interactive elements in WADA's educational platform, but this interactivity is limited to navigation visual elements and a kind of stepped uncovering of the information (like PowerPoint effects). Moreover, USADA, European Athletics Federation and World Athletics are using educational videos to enhance their contents, but these videos are limited to interviews with key-persons and introductory concepts. Overall, there is a clear opportunity to modernize these resources by incorporating more dynamic, interactive, and user-centered approaches to learning.

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[3] USADA static online educational material like "Four Things to Know about Competition Levels of Athletes", available at: https://www.usada.org/spirit-of-sport/athlete-competition-levels/

[4] USADA intro or demo video material, like the Anti-Doping 101, available at: https://www.usada.org/athletes/antidoping101/

[5] GLDF4CleanSport project (Erasmus+), https://www.gldf4cleansport.eu/#library

[6] https://europeanathletics.elearning.worldathletics.org/dashboard

Table 1. List of educational material formats developed by sport authorities found during the desk research

No.	Name of the organization or project which provides education	Pdf	Static websites	Video	Images	Presentations	Animation	Serious Games	Concept Maps	Digital Narration	Simulators	Hypothesis Testing	Pre-Check Form	Chat Bots	Personalization	AR / VR	Quizzes	Shared Knowledge	Learning Analytics
1	WADA		✓		✓												✓		
2	USADA	✓	✓	✓	✓														
3	HADA					✓											✓		
4	GLDF4CleanSport	✓																	
5	European Athletics Federation			✓	✓												✓		
6	World Athletics			✓	✓												✓		

3.3.2.   Teaching Methodologies in Anti-Doping Education

Anti-doping education should not be limited to information transfer; it must actively cultivate ethical decision-making and foster enduring values (Petróczi & Backhouse, 2020). Thus, ICT integration in antidoping education exceeds the limits of the educational content and should actively involve the teaching methods and overall learning models. In this section an overview of the most disruptive and effective teaching and learning methodologies will be briefly presented.

Problem-Based Learning (PBL)

PBL places learners in the center of complex, real-world situations. In anti-doping education, this could include analyzing doping cases or ethical dilemmas from the perspective of different stakeholders. This methodology encourages critical thinking, collaboration, and ethical reasoning (Hafizah et al., 2024; Hauw, 2017).

Microteaching using mobile applications

Apps like Athlete Central (WADA) facilitate daily compliance tasks such as submitting whereabouts while also offering educational reminders and content, contributing to microlearning in anti-doping education (Skoufa et al., 2022).

<u>Flipped classroom</u>

Following the model of the flipped classroom approach, students study theoretical material (e.g., anti-doping rules or banned substances) outside the classroom via videos or readings, and use class time for discussions and problem-solving. This enhances engagement and allows learners to digest complex content at their own pace (Kolliari-Turner et al., 2021).

<u>Case studies and ethical dialogues</u>

Teaching through case-based learning allows participants to explore real doping incidents (e.g., Ben Johnson, Lance Armstrong, or Russian doping scandal) to reflect on motivations, consequences, and ethical principles. Such approaches align with WADA's emphasis on values-based education (WADA, 2021a).

<u>Peer education and mentorship</u>

Athlete-centered peer education programs empower experienced athletes to serve as role models and mentors for younger athletes. This method enhances message credibility and fosters a culture of clean sport (Barkoukis et al., 2015).

<u>Collaborative learning</u>

Group activities and collaborative projects, such as creating awareness campaigns or developing educational materials, promote a sense of ownership and deeper understanding. According to Bandura's Social Cognitive Theory, peer modeling and social reinforcement are powerful drivers of behavioral change (Bandura, 2001).

3.3.3.   Conclusion

Anti-doping education must continue evolving to meet the complex realities of modern sport. The effective use of ICT tools—paired with dynamic and learner-centered methodologies—can significantly enhance the reach, relevance, and impact of educational programs. Future efforts should aim for interactivity, personalization, and ethical engagement, ensuring that ASPs are not just informed, but truly empowered to protect the integrity of sport. Best approaches for AntiDop project include:

- Use of interactive media content to enhance the educational material.
- Integration of game elements, both in learning materials and in overall learning experience (Serious games and gamification).
- Use of collaborative learning principles, even if the solution will be asynchronous.
- Extensive use of mLearning (eLearning using mobile devices like smartphones and tablets).
- A microteaching approach to offer short-learning experiences and bites of educational material for ASP who are busy or on the move.

- Problem-based learning using real-world examples and use cases taken from the news and historical records.
- The use of a LMS to host all the activities, have a single entry-page for all and apply safety and protection regulations.

3.4. Best practices to maximize results, raise awareness and engage users

The development of an effective anti-doping intervention should follow a comprehensive, inclusive, and psychologically grounded approach. The integration of these recommendations with best practices from current literature and policy (e.g., WADA's International Standard for Education, 2021a; Woolf, 2020; Ntoumanis et al., 2024) enhances the robustness and impact of the campaign.

a) Theory-based and multilevel design: Interventions should be grounded in evidence-based theoretical frameworks such as the Theory of Planned Behavior (TPB), Self-Determination Theory (SDT), Social Cognitive Theory (SCT), and Sport Drug Control Model (SDCM).

b) Values-based and developmentally appropriate education: Programs should emphasize values like integrity, honesty, and fairness, and should be tailored for athletes' age and developmental stage.

c) Use of digital and immersive technologies: Serious games (e.g., TARGET) and virtual reality interventions (e.g., VIRAL) allow athletes to interact with realistic doping dilemmas in a safe environment, improving moral reasoning and decision-making under pressure (Barkoukis et al., 2019b, 2021). Such technologies are especially impactful for younger populations.

d) Context-specific and culturally adapted interventions: Programs should demonstrate the effectiveness of customizing content to different sporting disciplines and participant profiles.

e) Coach-focused education: Educating coaches through programs like CoachMADE and ADVICE equips them with communication strategies and ethical reasoning tools to support athletes' choices. Coaches are pivotal social agents and influence athletes' norms and beliefs about doping (Nicholls et al., 2020a; Ntoumanis et al., 2021).

f) Parental and support personnel involvement: Multi-stakeholder interventions should include modules for parents and support staff, acknowledging their role in shaping athletes' value systems and emotional environments.

g) Critical literacy and media education: Interventions should integrate media literacy to help athletes critically evaluate supplement marketing and online misinformation. Such efforts build athletes' resistance to social influence and encourage informed decision-making.

h) Monitoring and evaluation mechanisms: As recommended by Woolf (2020), anti-doping education programs should incorporate robust evaluation frameworks to assess knowledge retention, attitude change, and behavioral outcomes. This ensures accountability and guides continuous improvement.

The creation of successful anti-doping interventions must be built upon principles of behavioral science, strategic communication, and inclusive design. The interventions should adopt a multi-target approach that includes not only athletes, but also athlete support personnel (ASP) such as parents, coaches, physicians, and sport administrators (Recommendation 1). Co-targeting ensures message synergy and helps build a cohesive clean sport culture (Recommendation 2).

The reach of the intervention must extend beyond sports organizations and federations to penetrate the broader social and local community (Recommendation 3). This aligns with findings from community-based interventions, which emphasize that anti-doping messages resonate more effectively when supported by wider social structures (Backhouse et al., 2016). To facilitate reach and engagement, a diverse array of media formats (e.g., videos, podcasts, VR, infographics) should be employed in a coordinated communication plan (Recommendation 4), with dissemination through both institutional and public channels (e.g., ministries, educational bodies) to ensure institutional embedding (Recommendation 5).

Tailoring content to different audiences is vital. Intervention messages must be demographically and psychologically customized (Recommendation 6), while maintaining consistency in core themes and values (Recommendation 7). For example, "teenspeak" and music-driven content may resonate with adolescents, while reliable, factual messaging may be more appropriate for parents and coaches. Additionally, messages should be framed positively to promote autonomy, mastery, and clean sport identity (Recommendation 8), avoiding ineffective fear-based appeals except in limited, short-term contexts (e.g., immediate consequences of rule violations).

To influence decision-making, the intervention must address key psychosocial variables such as attitudes, perceived norms, self-efficacy, and moral disengagement, especially during critical "trigger points" like performance plateaus, injuries, or transitions (Recommendation 9). These are established predictors of doping intentions in the literature (Ntoumanis et al., 2014; 2024). Furthermore, the intervention should involve co-creation with the target groups (Recommendation 10), thereby increasing relevance, authenticity, and buy-in.

Critically, the intervention should offer engagement opportunities (Recommendation 11), such as signing clean sport pledges, participating in online challenges, or contributing personal clean sport stories. This not only enhances commitment but also provides incentives for visible support. According to Woolf (2020), campaigns that encourage public action—however symbolic—can increase internalization of values.

Finally, the intervention should feature original, attention-grabbing content presented in unexpected or diverse settings (e.g., schools, tournaments, youth festivals) and utilize credible role models, especially elite athletes who embody clean sport values (Recommendation 12). Repetition of messages across time and formats (Recommendation 13) and implementation over an adequate timeframe (Recommendation 14) are essential to achieving behavioral impact and cultural change.

To achieve these recommendations the following steps and strategies are proposed:

1. Integrate doping prevention into athlete development pathways: Doping prevention should be embedded from the earliest stages of athlete development—not just introduced at the elite level. This means incorporating clean sport education into talent identification programs, youth academies, and school sport curricula (WADA, 2021a; Barkoukis et al., 2016). Early prevention fosters clean sport identity before maladaptive attitudes can form.

2. Promote clean sport through identity-based interventions: Interventions that focus on shaping athletes' identities as "clean competitors" have shown promise. Encouraging athletes to see clean sport as part of "who they are" (i.e., their personal values and group belonging) increases long-term

adherence (Gucciardi et al., 2020). Messaging should connect clean behavior with self-image, team culture, and professional pride.

3. Target social norms and perceived normative behavior: Correcting misperceptions about how common doping is, can reduce intentions to dope. Social norms-based messaging should emphasize that most athletes compete clean, reducing the perceived pressure to conform to unethical behavior (Ntoumanis et al., 2014). Peer testimonials, infographics, and data visualization are effective for this purpose.

4. Use gamification and behavioral nudges: Serious games (e.g., *TARGET*) and gamified e-learning platforms (e.g., *Real Winner*, *iRunClean*) increase engagement and retention. Behavioral "nudges" such as reminders, visual cues, and positive reinforcement during training can subtly reinforce clean sport choices (Galli et al., 2021; Woolf, 2020).

5. Encourage self-regulation and coping skills training: Programs should include modules that build psychological resilience, emotion regulation, and coping skills. This is particularly effective in buffering athletes against pressure during high-risk moments (e.g., injury, loss of form). Cognitive-behavioral training and motivational interviewing are promising methods here (Galli et al., 2023).

6. Foster a "safe to fail" environment: Many athletes fear speaking openly about doping-related issues. Facilitating open conversations in non-judgmental settings (e.g., workshops, team debriefs) allows them to explore ethical dilemmas, peer pressure, and grey areas in sport without fear of reprisal. This approach enhances moral engagement and decision-making skills (Barkoukis et al., 2019).

7. Collaborate with anti-stigma campaigns: Some athletes who refuse to dope face ridicule or isolation in performance-driven environments. Anti-doping messages should be embedded within broader efforts to promote mental health, body image positivity, and holistic development in sport. This helps reduce the stigma of vulnerability and resistance (Backhouse et al., 2016; Barkoukis et al., 2019).

8. Address supplement use as a gateway behavior and promote it as a safe alternative: There is strong evidence linking permissive attitudes toward supplement use with increased doping risk. Interventions should include education about supplement safety, contamination risks, and ethical considerations. Promoting informed and minimal use can serve as a protective factor (Barkoukis et al., 2020b).

9. Tailor education for post-career transition and return from injury: Athletes undergoing retirement, demotion, or injury are at elevated risk for doping behavior due to identity threats and performance anxiety. Tailored interventions addressing these high-risk transition periods should be integrated into athlete support services.

10. Evaluate interventions with longitudinal designs: Short-term evaluations are insufficient. Longitudinal and mixed-method assessments allow researchers and educators to track changes in attitudes, intentions, and behaviors over time. Feedback from participants should inform iterative improvements to content and delivery (Woolf, 2020).

4. Epilogue

4.1. Conclusions

The AntiDop Deliverable D2.1 presents an extensive and multi-dimensional overview of the contemporary landscape of anti-doping education, interventions, and support structures. The analysis encompasses historical evolution, policy frameworks, psychological underpinnings, digital and pedagogical tools, and a variety of existing programs targeting doping prevention. The evidence collected and synthesized in this deliverable yields several critical conclusions that point toward both strengths and gaps within the current anti-doping educational ecosystem.

4.1.1. The evolution of anti-doping policy and its educational implications

The emergence of global institutions such as WADA and the development of standardized frameworks like the World Anti-Doping Code have laid a robust foundation for harmonized anti-doping practices across nations. National Anti-Doping Organizations (NADOs), including HADA, have become instrumental in implementing localized education, testing, and enforcement programs. However, the enforcement-centric nature of early anti-doping efforts has only recently transitioned to a prevention-oriented educational approach. Education is now recognized as a strategic pillar, not just an ancillary activity. This marks a paradigm shift from punitive deterrence to values-based development, requiring an equivalent shift in methodologies and outreach mechanisms.

4.1.2. Athlete Support Personnel (ASP) as crucial change agents

D2.1 emphasizes the pivotal influence of Athlete Support Personnel (ASP)—including coaches, medical staff, and family members—on athlete behavior and doping decisions. Research confirms their role as ethical models and key decision influencers. Yet, educational programs for ASP remain inconsistent in scope, depth, and customization. Effective prevention must prioritize role-specific interventions for ASP, equipping them with not only technical knowledge but also ethical reasoning tools, leadership training, and communication strategies tailored to high-risk contexts.

4.1.3. Determinants of doping behavior: A multifactorial understanding

The literature review confirms that doping behavior is not driven by a single determinant but by a complex interplay of psychological, motivational, and contextual factors. Theories such as the Theory of Planned Behavior (TPB), Self-Determination Theory (SDT), and Social Cognitive Theory (SCT) provide robust frameworks for understanding these dynamics. Factors such as moral disengagement, perceived social norms, performance pressure, and low self-regulatory efficacy are particularly salient. Educational interventions must therefore be multifaceted—addressing not only knowledge deficits but also belief systems, motivational profiles, and the broader social environment in which athletes operate.

4.1.4. Traditional vs. modern educational interventions

While the report outlines a range of anti-doping programs (e.g., ADEL, Real Winner, iRunClean, Coach Clean), it also identifies a prevailing reliance on traditional, often static educational formats. These

include long-form PDFs, lectures, and text-heavy e-learning modules, which are less effective in engaging modern learners, particularly youth and digital natives. Although some platforms have adopted multimedia elements and basic interactivity, these efforts remain limited in scope and depth. The future of anti-doping education must move toward dynamic, immersive, and adaptive learning environments that leverage digital storytelling, simulations, gamified learning, and interactive decision-making.

4.1.5. Integration of ICT Tools and Pedagogical Innovation

ICT tools, including Learning Management Systems (LMS), mobile apps, serious games, and virtual reality, present significant opportunities to enhance the delivery and effectiveness of anti-doping education. Programs like TARGET and VIRAL demonstrate how gamification and simulation can improve moral reasoning, emotional engagement, and decision-making skills. These tools are particularly effective in promoting retention and attitudinal change. However, as the report notes, such innovations are not yet mainstreamed across all educational efforts. Wider adoption, proper evaluation, and contextual adaptation of these tools will be crucial to future success.

4.1.6. Best Practices for Program Design and Delivery

The report consolidates a set of best practices that should inform the design of future anti-doping education initiatives. These include:

- Theory-driven frameworks grounded in behavioral science
- Values-based, developmentally appropriate content
- Multi-stakeholder engagement, including ASPs, parents, and community actors
- Use of interactive and multimedia content
- Microlearning for time-constrained audiences
- Personalization and adaptive learning pathways
- Continuous evaluation and feedback mechanisms

These practices are aligned with WADA's International Standard for Education and supported by empirical research. Their implementation requires institutional coordination, technological investment, and inclusive stakeholder involvement.

4.1.7. Gaps in Accessibility, Localization, and Inclusivity

Despite the increasing availability of anti-doping content, many materials remain linguistically and culturally homogeneous, limiting their reach to non-English speakers or marginalized communities. Accessibility for users with disabilities is also under-addressed. For truly global impact, education programs must be localized in language, culture, and context, and designed with universal accessibility principles in mind.

4.2. How the findings will support the AntiDop project

D2.1 reveals a sector in transition—moving from compliance-based models to holistic, education-driven approaches. The growing recognition of ethical development, psychological resilience, and the power of

digital learning must now be matched by practical implementation. The AntiDop project is well-positioned to contribute meaningfully by translating these insights into cutting-edge, accessible, and impactful educational tools. Continued collaboration, innovation, and critical evaluation will be key to ensuring that anti-doping education evolves in line with the challenges and opportunities of modern sport.

The findings of D2.1 directly inform the goals of the AntiDop project, which aims to design innovative, evidence-based training missions focused on supplement use and ethical decision-making among Athlete Support Personnel. The document offers a rich foundation for the co-design of materials that:

•   Address psychological determinants of doping

•   Utilize digital platforms and microlearning

•   Engage ASPs as multipliers of clean sport culture

•   Incorporate values-based and role-specific learning experiences

•   Are adaptable across contexts and responsive to learner feedback

Finally, this document will be used as a reference to the following deliverables, especially D2.2 and D2.3.

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