Summary of Performance Enhancing Drugs Potentially Used in Rugby

Image	Drug Class	Example	Postulated Performance Enhancing Effects	Evidence of Effectiveness	Adverse Effects	WADA Legal Status
	**Central stimulants Amphetamines, ephedrine**	Ephedra Ephedrine Pseudoephidrine Methylephadrine Senephrine Caffeine	Stimulates exercise performance, euphoria, relieves fatigue, promotes self-confidence, muscle strength, endurance, improved reaction times; enhance weight loss.	May increase time to exhaustion by masking the physiological response to fatigue. Effective therapeutic dose 14mg/70kg.	Somatic: Anxiety, tremor, tachycardia, hypertension & hyperthermia. Myocardial infarction (heart attacks reported). Anxiety, aggressive behaviour & paranoid psychoses.	Prohibited by WADA. Ephedrine and methylephadrine are permitted at urine concentrations less than 10 micrograms/ml. Pseudoephidrine is permitted at doses that result in concentrations of less than 150 micrograms per ml in urine.
	**Caffeine**	Coffee Red Bull Bioplus	Caffeine may increase performance during submaximal steady-state aerobic exercise.	More beneficial in endurance sports where caffeine mobilises fat stores and encourages working muscles to use fat as an energy source, resulting in glycogen sparing. Centrally, caffeine may affect the rate of perceived exertion (RPE) and subjectively make athletes feel less tired. Variations in caffeine metabolism result in differing individual responses.	Anxiety, tremor, tachycardia and hypertension. Insomnia. Increased gastric acid production. High caffeine intake may accelerate bone loss. Combinations of caffeine with other stimulants (e.g. ephedrine) have been linked to fatal events.	Permitted since 2009; WADA will continue monitoring the status of caffeine.

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   	**Anabolic Androgenic Steroids**	Testosterone esters - Testosterone cypionate - Testosterone enanthate (Primoteston) - Testosterone propionate Testosterone derivates - Methyltestosterone - Methandrostenolone (Dianabol) - Fluoxymesterone (Halotestin) - Boldenone undecylenate (Equipoise) Nandrolone derivates - Nandrolone decanoate (Deca-Durabolin) - Ethylestrenol (Maxibolin, Orabolin) - Trenbolone Dihydrotestosterone derivates - Oxandrolone (Anavar) - Stanozolol (Winstrol) - Oxymetholone (Anadrol) Tetrahydrogestinone (THG)	Increased muscle strength, power & speed. The side-effect of increased aggression may also be perceived as a benefit in competitive sport.	Potential significant positive effects on fat-free mass, muscle size and strength especially when combined with weight training. Anabolic effects include: increased protein synthesis from amino acids, increased appetite, increased bone remodelling and growth, and stimulation of bone marrow, which increases the production of red blood cells; stimulate the formation of muscles cells and hence cause an increase in the size of skeletal muscles, leading to increased strength.	<u>Physical</u> Endocrine effects including testicular atrophy, sterility, gynaecomastia in males; virilization, hoarse voice, clitoral hypertrophy & amenorrhoea in women. Somatic effects including an unfavourable change in cholesterol & lipid profile. Cardiovascular effects, cardiomyopathy, hypertension & sudden cardiac death hepatic complications – cholestasis, peliosis, adenomas; premature closure of epiphyseal growth plates in adolescents. <u>Neuropsychiatric</u> Irritability Hyperactivity Aggression Depression Delusions Increased euphoria, energy & sexual arousal; effects exacerbated by alcohol.	Prohibited

		• Other anabolic agents (eg, desbuterol, androgen-receptor modulators)				
	**Hormone antagonists and modulators**	• **Aromatase inhibitors** (e.g. anastrozole, letrozole) • **Selective oestrogen-receptor modulators** (e.g. tamoxifen) • **Other antioestrogenic substances** (e.g. clomiphene) • **Agents modifying myostatin functions** (eg, myostatin inhibitors)	Anti-oestrogenic agents are used predominantly to counter the oestrogenic side-effects of anabolic androgens, particularly aromatizable steroids.	None as a performance-enhancing agent. May decrease side-effects of anabolic-androgen use such as gynaecomastia (male breast development), fat build-up and fluid retention.	Headache, nausea, skin rash and impotence in men. In both sexes, joint pains, muscle cramps and hot flushes. Less often blood clots, strokes, uterine cancer and cataracts.	Prohibited
	**Steroid Precursors**	Androstenedione and Dehydroepiandrosterone (DHEA)10-13	Increase testosterone and lean muscle mass.	Little evidence of any meaningful increase in testosterone levels, strength gains or alteration in body composition.	Oestrogenic effects such as gynaecomastia. Reduced HDL (protective) cholesterol	Prohibited

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 	**Human growth hormone**	Jintropin Somatropinne HgH HgH 30000 Secretagougue-One Rejuevenation	Increase muscle protein synthesis and strength; decreased body fat; prevention of muscle and tendon tears; improved recovery.	Research is limited and shows mixed results. Probable increases in lean mass, reduction in fat and enhanced strength especially when combined with anabolic androgens. Anabolic effects on connective tissue may aid recovery from training and competition.	Gigantism in younger athletes, acromegaly in adult athletes, hypothyroidism, cardiomyopathy, cardiac failure, hypercholesterolemia, ischemic heart disease, myopathies, arthralgia, carpal tunnel syndrome, diabetes, impotence, osteoporosis, menstrual irregularities in women, CJB (creutzfeldt-jakob disease or mad cow disease possible when the hGH is maintained from cadavers) oedema, needle contamination (hepatitis and HIV/AIDS).	Prohibited

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 	**β-2-agonists** • All β-2-agonists including their D and L isomers	Salbutamol, Salmeterol, Terbutaline, Eformoterol	Perceived benefit on breathing efficiency, oxygen delivery and performance in athletes.	Oral administration of salbutamol has shown improvements in muscle strength and endurance. Inhaled agents show no benefit in non-asthmatics.	Tremor, nervousness, headache, muscle cramps, dry mouth, and palpitations. Other symptoms may be tachycardia (rapid heart rate), arrhythmias, flushing, myocardial ischaemia, and disturbances of sleep and behaviour. Rarely occurring, but of importance, are allergic reactions of paradoxical bronchospasm, urticaria, angioedema, hypotension, and collapse, whilst high doses may cause hypokalaemia (low potassium levels),	Inhalation of most β-2-agonists requires a therapeutic-use Exemption. Salbutamol is permitted without a TUE and only a declaration of use at testing for doses less than 1 600 mg/24 hours and under urine concentrations of 1 000 nanograms per ml. Salmeterol is also permitted without a TUE. Oral & injectable administration are prohibited.
	**Clenbuterol**	Spiropent, Prontovent, Novegam, Clenasma, Broncoterol	Strength gain & fat burning	β_2 agonist used in asthma; also may increase muscle hypertrophy & strength and increase lipolysis	Increased heart rate, tremors, muscle cramps, palpitations, insomnia, nervousness, and headaches	Prohibited

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	**Diuretics and other masking agents** • Diuretics • Epitestosterone • Probenecid • α-reductase inhibitors (eg, fi nasteride, plasma expanders)	Diuretics: Lasix (furosemide) Bumex (bumetanide) Hydrodiuril (hydrochorothiazide) Midamor (amiloride) Epitestosterone: Probenecid: Benemid	Used as masking agents to dilute the presence of performance-enhancing agents in the urine.	None. Diuretics may impair performance by causing muscle weakness, cramping and lethargy. Epitestosterone is an inactive epimer of testosterone.	Diuretics may alter sodium, potassium & calcium concentrations, cause muscle weakness, cramps, lethargy, gout, arrhythmias, nausea, vomiting and depression. Probenecid may worsen a gout attack, cause gastritis and increase the risk of kidney stones.	Prohibited
	**Erythropoietin**	Epogen Epotin Betapoeitin Remipoeitin Shanpoeitin Epokine NeoRecormon	Increase oxygen delivery to tissues and improves endurance ability.	Effectively promotes red cell survival through inhibiting cell apoptosis; also promotes angiogenesis.	Significant and dangerous Hypertension, polycythaemic disorders, thromboembolism, CVAs, myocardial infarction.	Prohibited
	**Sodium bicarbonate**	Bicarbonate of soda Baking soda Cooking soda Bread soda	Increased buffering capacity of acid improves ability to perform maximal exercise.	Effective in high intensity exercise by buffering muscle-produced acid; used at doses of 20-30g in 500ml or more of water.	Mostly gastrointestinal including nausea, vomiting and diarrhoea.	Legal
	**Narcotic analgesics**	Pethidine Morphine Codeine (e.g. Stopayne)	Allows extension of exercise performance	Not necessarily ergogenic	Harmful if used to allow participation of an athlete with a severe injury. Short term – respiratory depression, nausea, drowsiness Long term – tolerance & addiction.	Codeine is legal. Derivatives of morphine & heroin are prohibited.

	**Thyroid Hormone**	Eltroxin	Enhances effect of anabolic agents; offsets effects of hypocaloric diet.	Paucity of research in athletic context; contra-indicated	Heart palpitations, agitation, shortness of breath, irregular heartbeat, sweating, nausea, irritability, tremors, restlessness, and headaches	Permitted