



2022 NSCA *NATIONAL* CONFERENCE

July 6-9, 2022 | New Orleans & Online
#NSCACon22

› *KNOWLEDGE*
› *ADVANCEMENT*
› *COMMUNITY*

CONFLICT OF INTEREST STATEMENT

I have no actual or potential conflict of interest
in relation to this presentation.

Introduction

Before I let you know what is in this presentation, I will let you know what is not:

- No ethics
 - I am a physiology professor, not an ethics professor
- No judgement
- Not intended to be help anyone get away with using drugs!

Introduction

What is in this presentation?

- WADA's official report



- Scientific papers to discuss report

**WORLD
ANTI-DOPING
AGENCY**
play true

2020 ANTI-DOPING TESTING FIGURES

*Please click on the sub-report title to access it directly.
To print, please insert the pages indicated below.*

[Executive Summary – pp. 2-9 \(7 pages\)](#)

[Laboratory Report – pp. 10-36 \(27 pages\)](#)

[Sport Report – pp. 37-137 \(101 pages\)](#)

[Testing Authority Report – pp. 138-244 \(107 pages\)](#)

[ABP Report-Blood Analysis – pp. 245-279 \(35 pages\)](#)

Outline

- What athletes are taking
- How many athletes are being caught
- How WADA is trying to prevent it

What athletes are taking:

- Prohibited List



SUBSTANCES & METHODS PROHIBITED AT ALL TIMES

S0 Non-approved substances	4
S1 Anabolic agents	5
Some of these substance(s) may be found, without limitation, in medications used for the treatment of e.g. male hypogonadism.	
S2 Peptide hormones, growth factors, related substances, and mimetics.....	7
Some of these substance(s) may be found, without limitation, in medications used for the treatment of e.g. anaemia, male hypogonadism, growth hormone deficiency.	
S3 Beta-2 agonists.....	9
Some of these substance(s) may be found, without limitation, in medications used for the treatment of e.g. asthma and other respiratory disorders.	
S4 Hormone and metabolic modulators	10
Some of these substance(s) may be found, without limitation, in medications used for the treatment of e.g. breast cancer, diabetes, infertility (female), polycystic ovarian syndrome.	
S5 Diuretics and masking agents	12
Some of these substance(s) may be found, without limitation, in medications used for the treatment of e.g. heart failure, hypertension.	
M1 – M2 – M3 Prohibited Methods.....	13

What athletes are taking:

- Prohibited List



SUBSTANCES & METHODS PROHIBITED IN-COMPETITION

S6 Stimulants	14
Some of these substance(s) may be found, without limitation, in medications used for the treatment of e.g. anaphylaxis, attention deficit hyperactivity disorders (ADHD), cold and influenza symptoms.	
S7 Narcotics	16
Some of these substance(s) may be found, without limitation, in medications used for the treatment of e.g. pain, including from musculoskeletal injuries.	
S8 Cannabinoids	17
S9 Glucocorticoids	18
Some of these substance(s) may be found, without limitation, in medications used for the treatment of e.g. allergy, anaphylaxis, asthma, inflammatory bowel disease.	

SUBSTANCES PROHIBITED IN PARTICULAR SPORTS

P1 Beta-blockers	19
Some of these substance(s) may be found, without limitation, in medications used for the treatment of e.g. heart failure, hypertension.	

Which do you think athletes are caught taking the most?

- Anabolic Agents
- Peptide Hormones
- Beta-2 Agonists
- Hormone and Metabolic Modulators
- Diuretics and Masking Agents
- Prohibited Methods
- Stimulants
- Narcotics
- Cannabinoids
- Glucocorticoids
- Beta Blockers

What athletes are being caught taking:

Substance Group	% of all ADAMS reported findings
S1 Anabolic Agents	47%
S6 Stimulants	15%
S5 Diuretics and Other Masking Agents	14%
S4 Hormone and Metabolic Modulators	8%
S9 Glucocorticosteroids	5%
S3 Beta-2 Agonists	4%
S8 Cannabinoids	3%
S2 Peptide Hormones, Growth Factors and Related Substances	3%
S7 Narcotics	0.3%
P1 Beta-Blockers	0.9%
M1 Enhancement of Oxygen Transfer	0%
M2 Chemical and Physical Manipulation	0%
TOTAL*	

Why are anabolic agents so common?

Because they really, really, really work

My all-time favorite paper:

Am J Physiol Endocrinol Metab
281: E1172–E1181, 2001.

Testosterone dose-response relationships in healthy young men



SHALENDER BHASIN,¹ LINDA WOODHOUSE,¹ RICHARD CASABURI,³ ATAM B. SINGH,¹
DIMPLE BHASIN,³ NANCY BERMAN,³ XIANGHONG CHEN,⁴ KEVIN E. YARASHESKI,⁴
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AND THOMAS W. STORER²

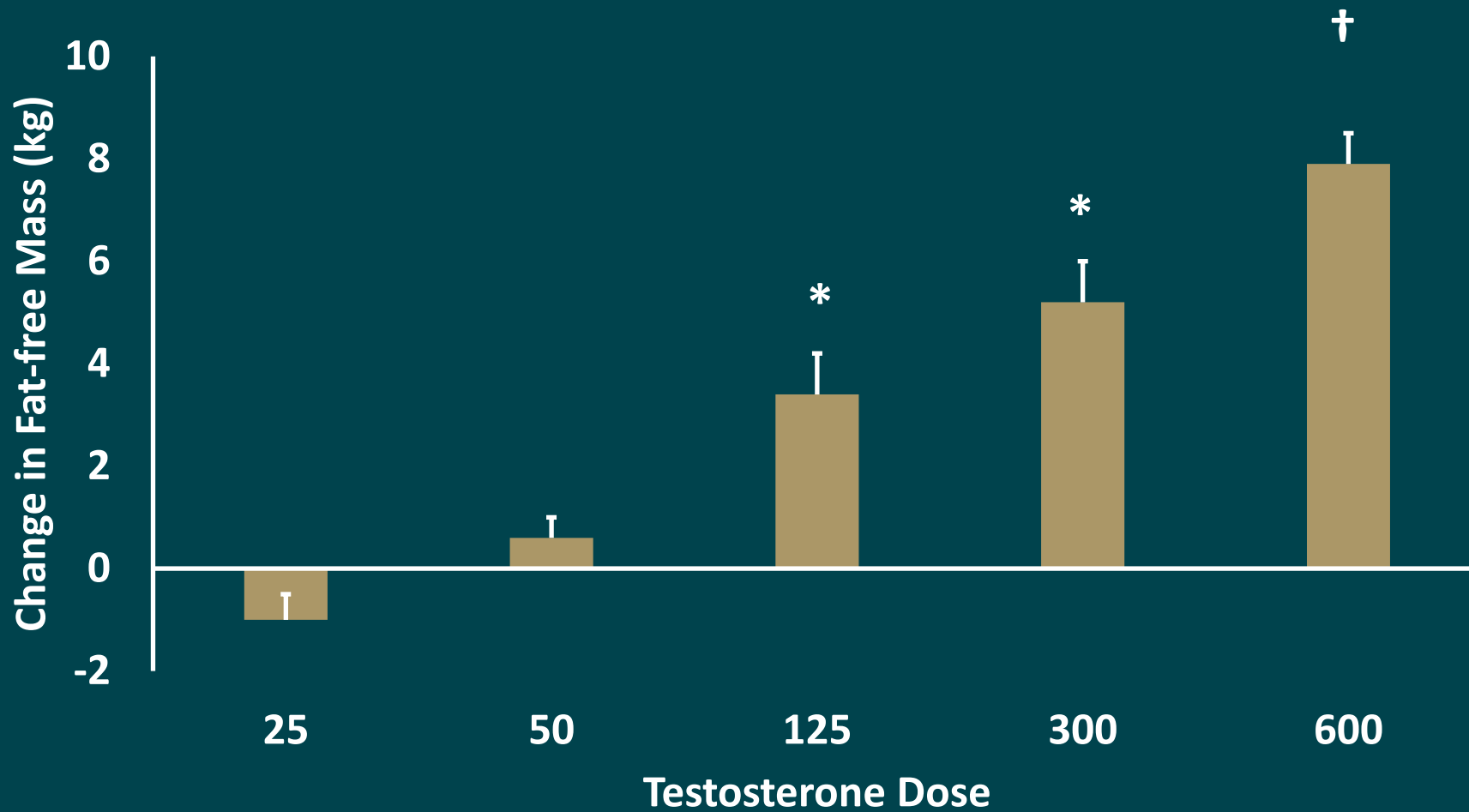
¹*Division of Endocrinology, Metabolism, and Molecular Medicine, Charles R. Drew University of Medicine and Science, Los Angeles 90059;* ²*Laboratory for Exercise Sciences, El Camino College, and* ³*Harbor-University of California Los Angeles Medical Center, Torrance, California 90502; and* ⁴*Biomedical Mass Spectrometric Research Resource, Department of Internal Medicine, Washington University, School of Medicine, St. Louis, Missouri 63110*

Received 13 March 2001; accepted in final form 27 July 2001

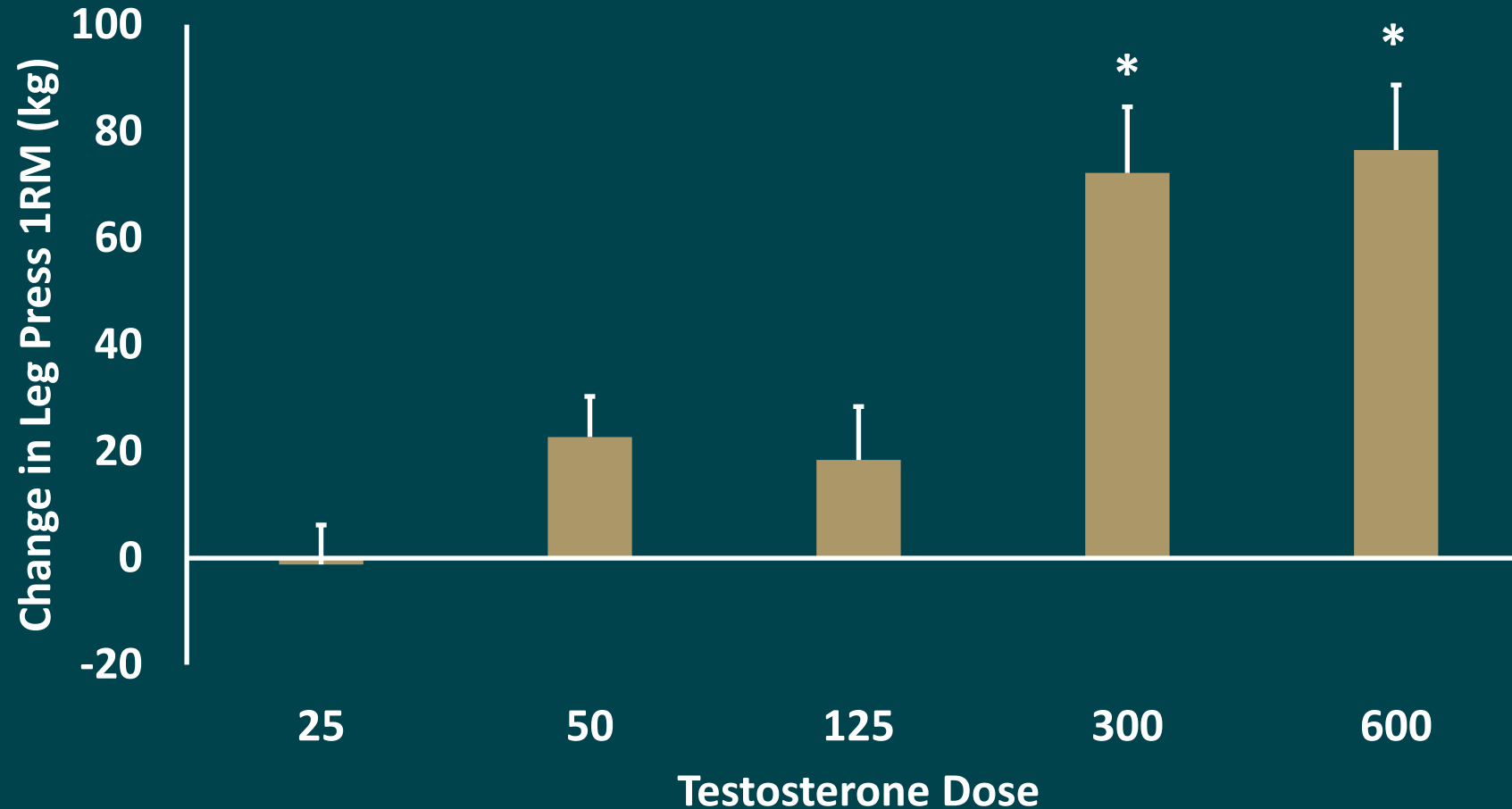
Bhasin et al. (2001)

- 61 young men (18-35)
- T Enanthate (mg/week) for 20 weeks:
 - 25
 - 50
 - 125
 - 300
 - 600
- GnRH agonist (desensitizes)
- Effects on:
 - Strength
 - Body composition
- **NO TRAINING!**

Changes in Fat-free Mass Following 20 Weeks of Testosterone Supplementation



Changes in Leg Press 1RM Following 20 Weeks of Testosterone Supplementation



Benefit vs. Risk

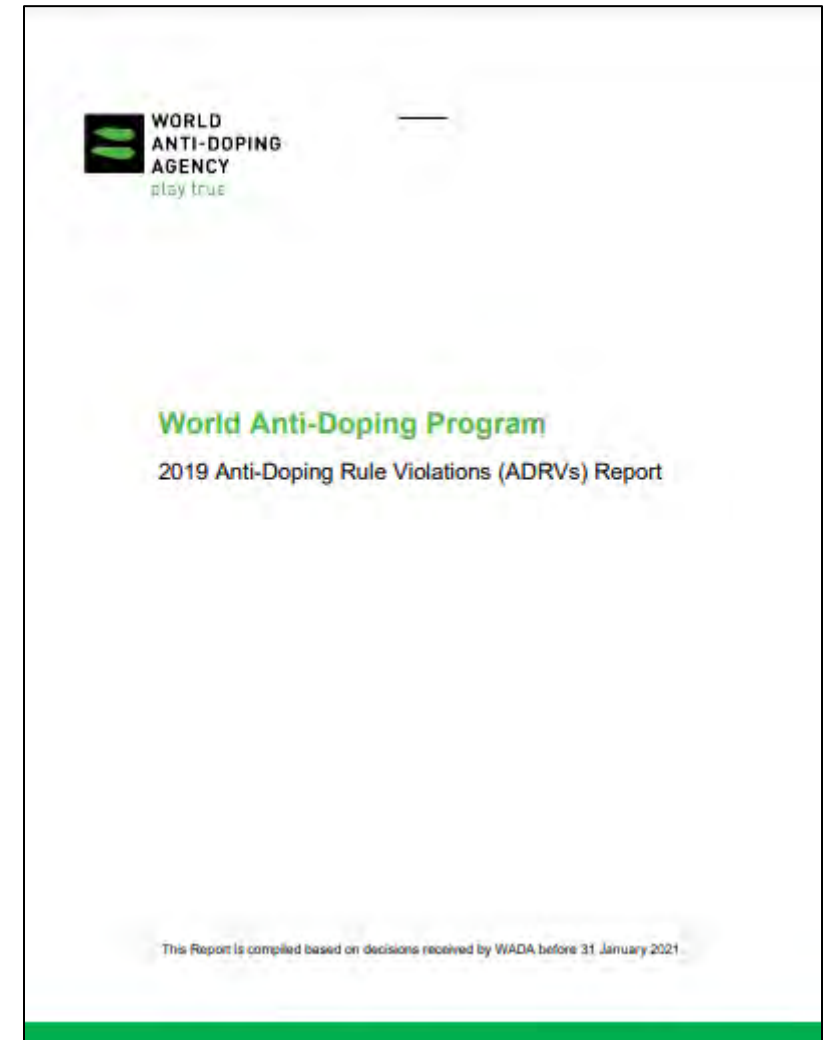
- How many athletes are getting caught?

Show of hands: What % of athletes do you think are taking something on the prohibited list?

- 0-10%
- 11-20%
- 21-30%
- 31-40%
- 41-50%
- 51-60%
- 61-70%
- 71-80%
- 81-90%
- 91-100%

Anti-Doping Rule Violation Report

- ADRV Report



Anti-Doping Rule Violation Report

- 278,047 samples were collected in 2019
- 1,537 samples confirmed as ADRVs

- ADRV Report

0.55%



- *544 were still pending, assuming all confirmed as ADRVs: 0.75%
- **Also 377 non-analytical ADRVs

Is sport clean? Or is it just hard to catch offenders?

- Let's talk about how they catch offenders
 - Every substance has a different test, we'll focus on testosterone (anabolic agents overwhelming majority of positive tests)

Urine test for testosterone use

- Based on epitestosterone
 - 5 alpha reductase inhibitor
 - Prevents T conversion to DHT (strong androgen)
 - Competes with T for AR
 - Reduces T signal
- Its functions are not as important as this:
 - It is produced at a 1:1 with T
- Therefore, $\uparrow$ T:E indicative of exogenous testosterone use

Another great study

J. Steroid Biochem. Molec. Biol. Vol. 44, No. 2, pp. 179–189, 1993
Printed in Great Britain

0960-0760/93 \$6.00 + 0.00
Pergamon Press Ltd



LONG-TERM ADMINISTRATION OF TESTOSTERONE ENANTHATE TO NORMAL MEN: ALTERATIONS OF THE URINARY PROFILE OF ANDROGEN METABOLITES POTENTIALLY USEFUL FOR DETECTION OF TESTOSTERONE MISUSE IN SPORT

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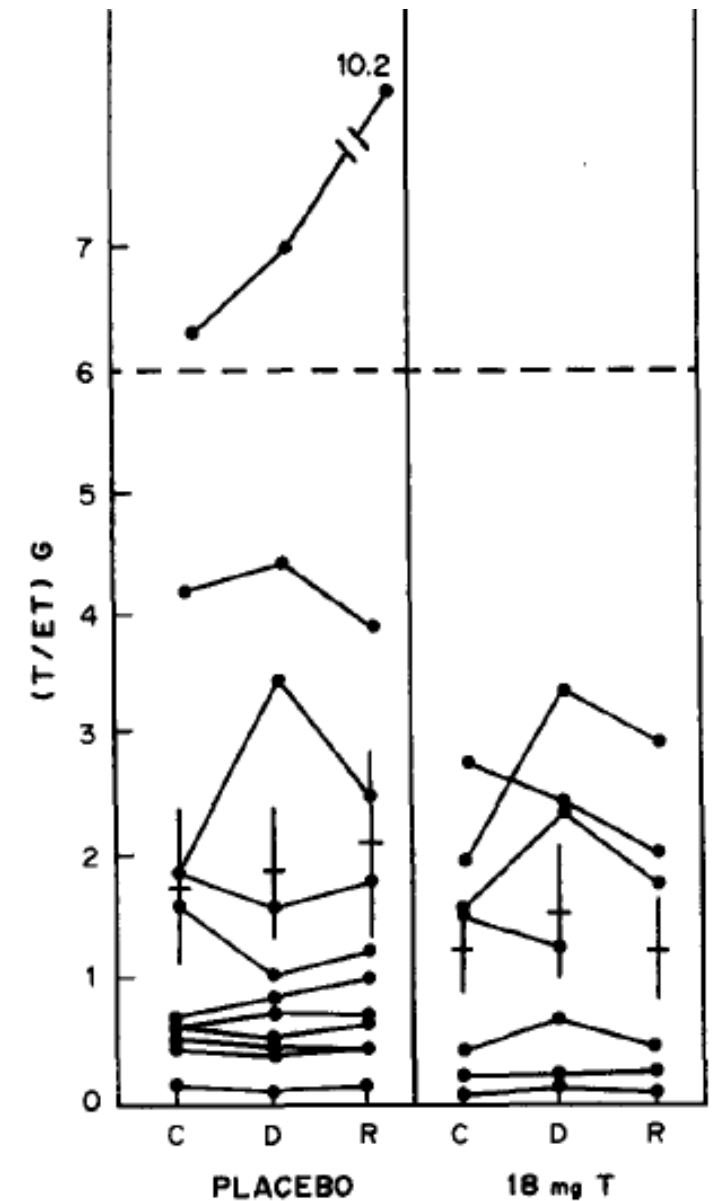
²Gerontology Research, Education and Clinical Center, Department of Veterans Affairs Medical Center and Population Center for Research in Reproduction, Department of Medicine, University of Washington, Seattle, WA 98108, U.S.A.

Dehennin & Matsumoto (1993)

- Testosterone enanthate
 - 34 men
 - mg/week for 6 months
 - 0
 - 18
 - 72
 - 216
 - Measure T:E
- 3 time points
 - C – Baseline
 - D – During (unclear when)
 - R – ~75 days after last dose

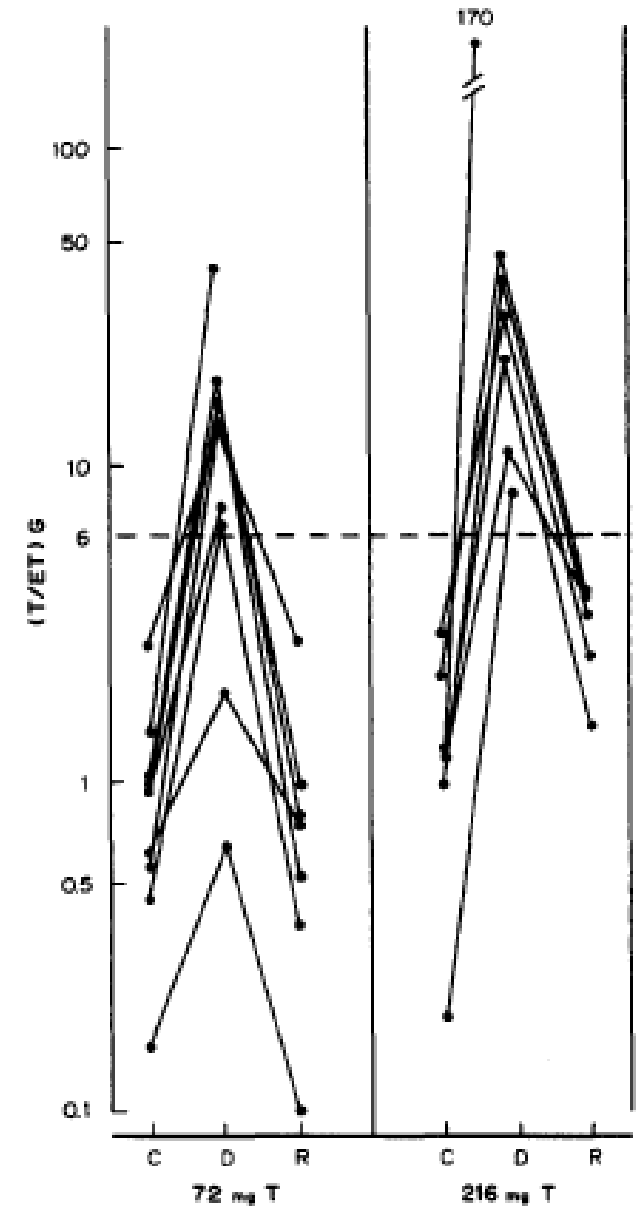
Dehennin & Matsumoto (1993)

Fig. 1. Variations of the (T/ET)G ratio in different subjects, at the end of the periods of control (C), drug (D) administration (18 mg T/week) and recovery (R). Means $\pm$ SEM are indicated. (T/ET)G = 6 is the critical value above which T administration is considered as proven by sports authorities.



Dehennin & Matsumoto (1993)

Fig. 2. Variations of the (T/ET)G ratio in different subjects, at the end of the periods of control (C), drug (D) administration and the recovery (R). Administered doses of T correspond to respectively 72 and 216 mg/week.



Dehennin & Matsumoto (1993)

- “False positive or negative testing emphasizes the need for improvement of testing procedures.”
- There is a new follow up test, and we’ll get to that soon
- But, this test remains the first test used to identify testosterone use to this day

But that's not the bombshell

- What comes next will probably surprise you

Major flaw in testing procedure

- 4:1 ratio test is based on testosterone being excreted in the urine
- A gene named “UGT2B17” encodes a key enzyme that leads to androgens showing up in the urine
- If you don’t have this gene, you won’t pass increased testosterone

How common is it?

- Strahm et al. (2009)



- The steroid profile of 57 Africans, 32 Asians, 50 Caucasians and 32 Hispanics was determined

Deletion percentages:

- African: 22%; Asian: 81%; Caucasian: 10%; Hispanic: 7%

Next study goes the next level

- Going to give subjects with UGT2B17 deletion testosterone and see if they pass/fail the test...

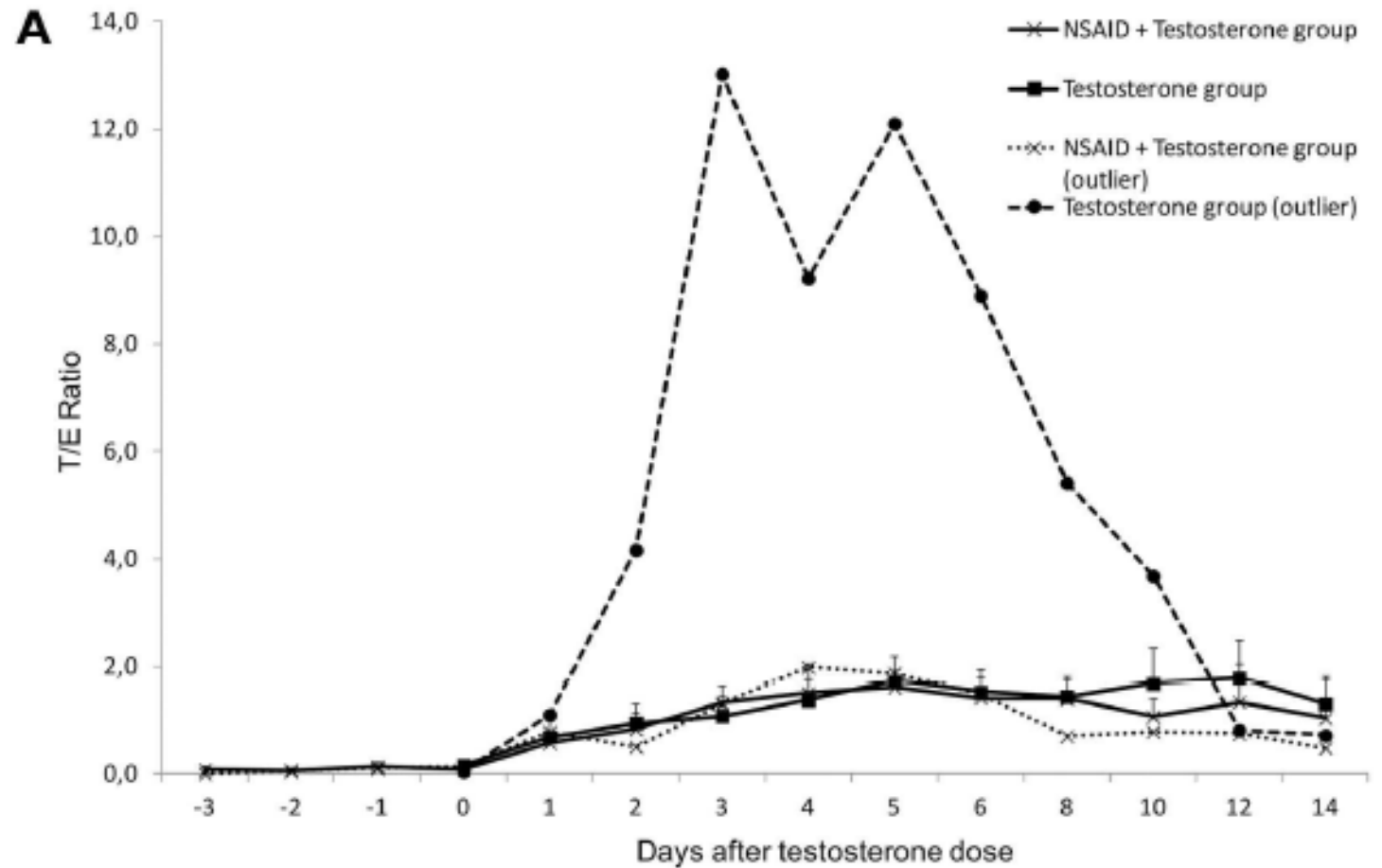
Use of testosterone in UGT2B17 del/del

- Lundmark et al. (2013)
 - 8 subjects with del/del
 - Single dose of 500 mg
 - 600 mg was used in the Bhasin study earlier
 - T:E measured every day, 3 days before, 17 after



Use of testosterone in UGT2B17 del/del

- Lundmark et al. (2013)



Use of testosterone in UGT2B17 del/del

- Lundmark et al. (2013)



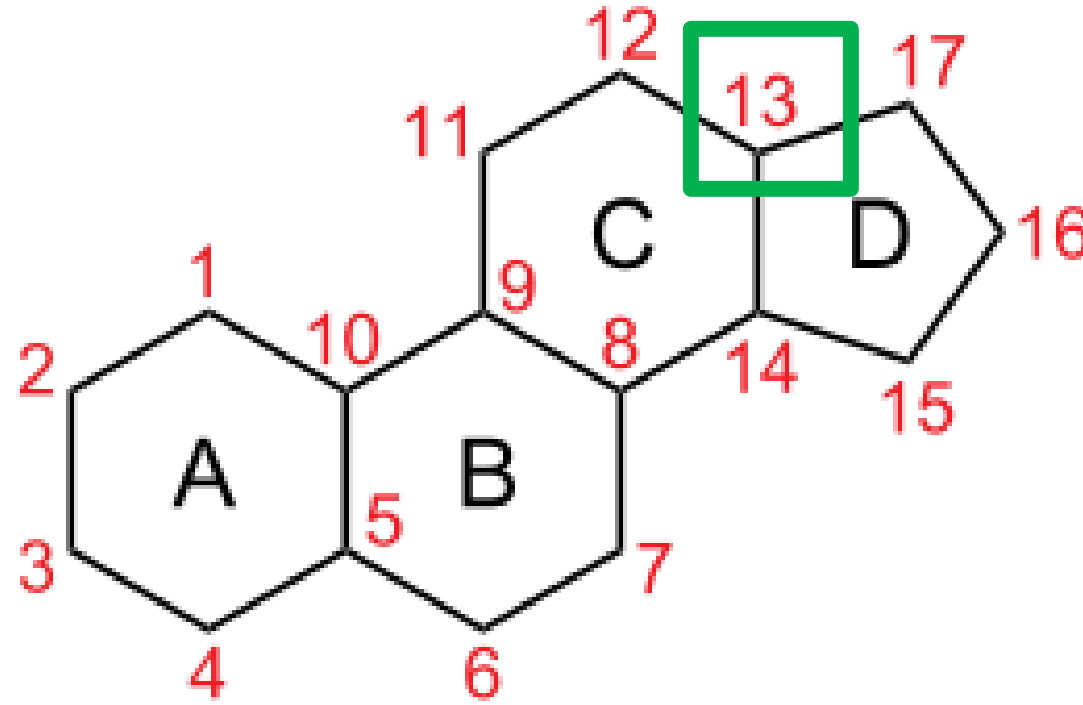
- Outside of the 1 outlier, everyone passed the test, even the next day
- Remember the prevalence from earlier:
- African: 22%; Asian: 81%; Caucasian: 10%; Hispanic: 7%

Use of testosterone in UGT2B17 del/del

- What could you do with this information?

I did tell you there is another test...

- If T:E is >4, a secondary analysis can be performed
- Involves gas chromatography mass spectrometry



I did tell you there is another test...

- Synthetic steroids made from plant phytosterols
 - These lack carbon 13, but carbon 12 is normal
 - Therefore $^{13}\text{C}/^{12}\text{C}$ ratio used to determine doping
 - Compared to Pdiol
 - A substance whose $^{13}\text{C}/^{12}\text{C}$ ratio is not altered by doping
- Why is this not just the standard test?

Other factors...

- We've been assuming this whole time that the drug testing officer receives the person's real urine...

Whizzinator

- Elbe et al. (2016)



Sports Med (2016) 46:15–22
DOI 10.1007/s40279-015-0388-6



ORIGINAL RESEARCH ARTICLE

The Urine Marker Test: An Alternative Approach to Supervised Urine Collection for Doping Control

Anne-Marie Elbe¹ · Stine Nylansted Jensen¹ · Peter Elsborg¹ · Monika Wetzke² ·
Getachew A. Woldemariam³ · Bernd Huppertz⁴ · Ruprecht Keller⁴ ·
Anthony W. Butch³

to the back of their penises. Furthermore, in the UK DCOs were warned about the “Whizzinator”, a fake penis that comes complete with drug-free urine, and a heater pack to ensure it is maintained at body temperature [15]. Other

Is anybody really using and getting away with that?

- Mike Tyson admitted to using it his whole career in his autobiography...



What is the future?

- The Athlete Biological Passport



- The Athlete Biological Passport
- “...monitor selected biological variables over time that indirectly reveal the effects of doping, rather than attempting to detect the doping substance or method itself.”

Athlete Biological Passport

- The Athlete Biological Passport



Included metrics:

Haematological Markers

- Hct, Hb, RBC, many others

Steroidal Markers

- T/E, T, E, plus derivatives

Athlete Biological Passport

- The Athlete Biological Passport



- Does not replace other testing
- In/out of competition
 - No notice
- Target athletes
 - Based on prospects for long-term elite level competition

Summary

- Drugs can be very effective, temptation to use is strong
- Catching users is very hard
- ABP is a solid step forwards

Questions?