



# First steps in doping prevention!

BASIC-Level



## What is doping?

- **Performance enhancement** by the usage of prohibited substances or prohibited methods
- **Unfair act** holding health risks

### International regulations:

- World Anti-Doping Code
- The Prohibited List





# What is the origin of doping?

*Performance enhancement...*

ancient times,  
roman empire,  
middle Ages

Herbs, fungi and testis of the bull



1896

First doping case leading to death: Arthur Linton  
(*Strychnine*)

1904

Doping case in marathon: Thomas Hicks  
(*Stimulants, Alcohol*)



1939  
- 1945

World War II: Aviators took stimulants



# What is the origin of doping?

1960s

Start of extreme abuse of anabolics

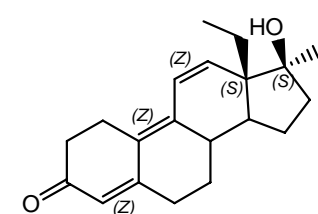


end 1980s

Increase of EPO abuse in endurance sports  
(*Erythropoietin*)

2003

Discovery of designer steroid THG  
(*Tetrahydrogestrinone*)



2007

Various doping cases at the Tour de France





## What are the time markers of anti-doping activities?

1968

First doping controls at the Olympics

1988

First out-of-competition testing in Germany

1999

World Anti-Doping Agency (WADA)



2004  
2007

World Anti-Doping Code and International Standards

International Convention against Doping in Sport





# Where do we find doping or drug abuse?



**competitive sports**



**doping**



**leisure sports**



**drug abuse**



**lifestyle**



**drug abuse**



**work load**



**drug abuse**

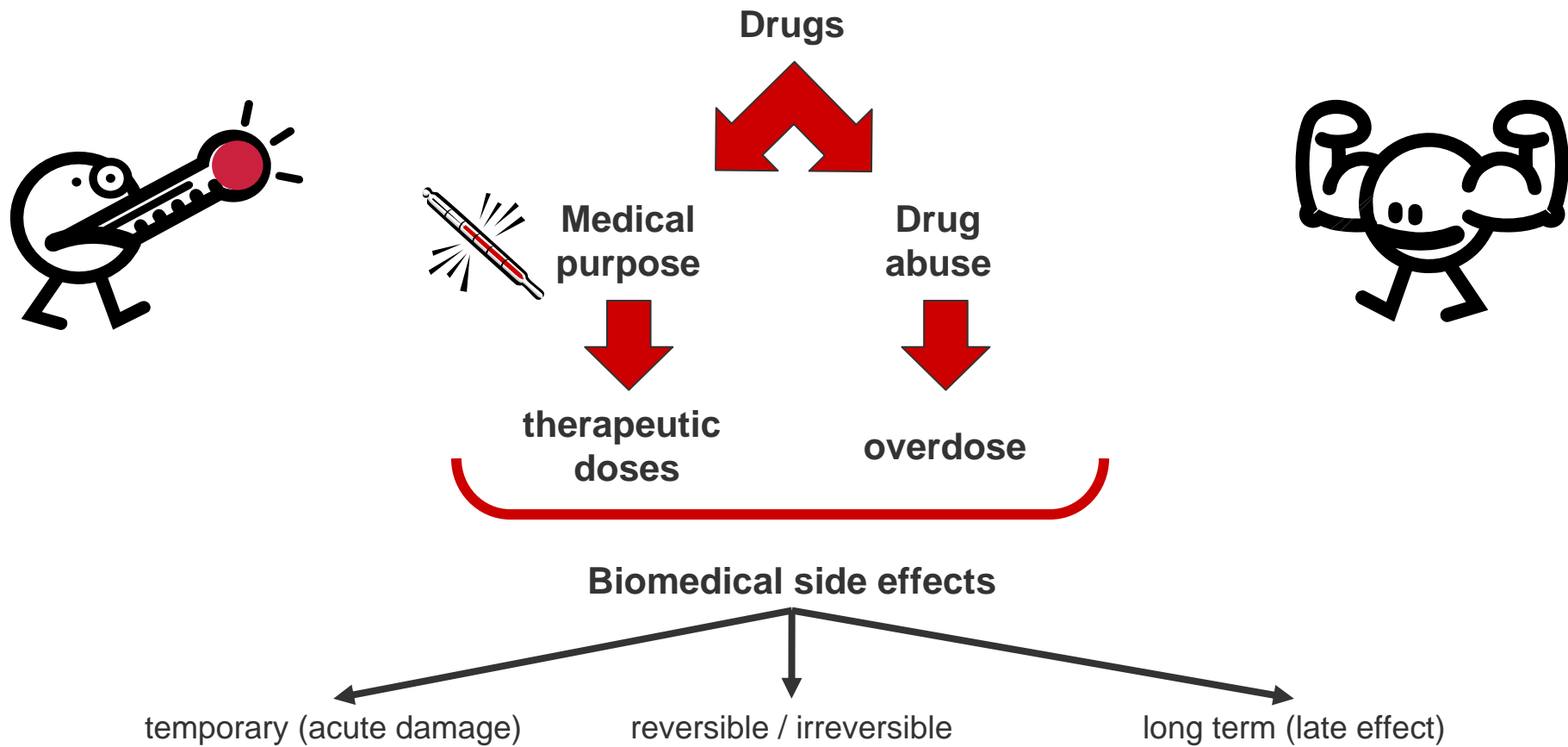


## Summary & keywords to know

- **Prohibited substances and methods**
- **World Anti-Doping Code (anti-doping rules)**
- **The Prohibited List (substances and methods)**
- **Doping history goes back to ancient times**
- **Drug abuse is not only located in competitive sports**
- **Doping = Drug abuse**
  - ⇒ **A problem of the entire societal culture!**



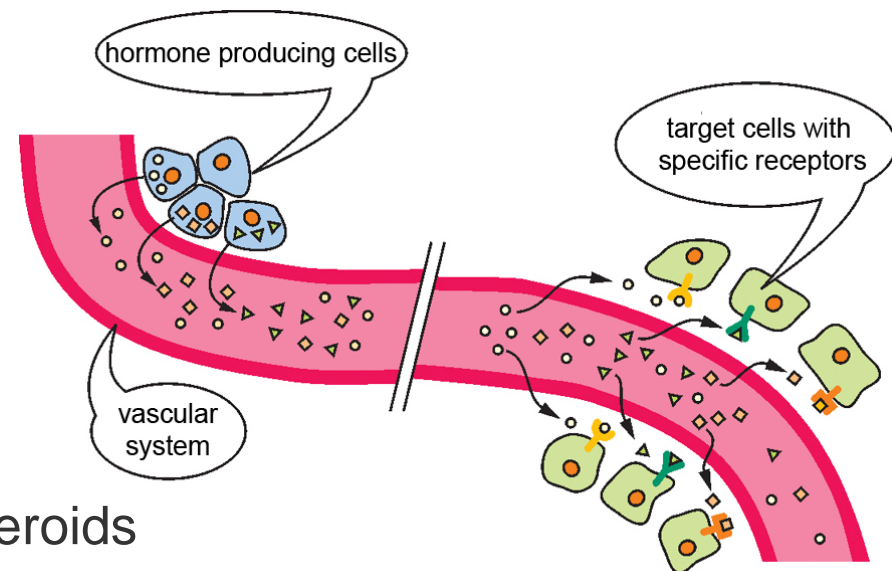
# The dual character of drugs/doping substances



## What are anabolic steroids?

- Anabolic-androgenic steroids (AAS) are hormones
- Regulation of specific body functions, e.g. muscle build-up

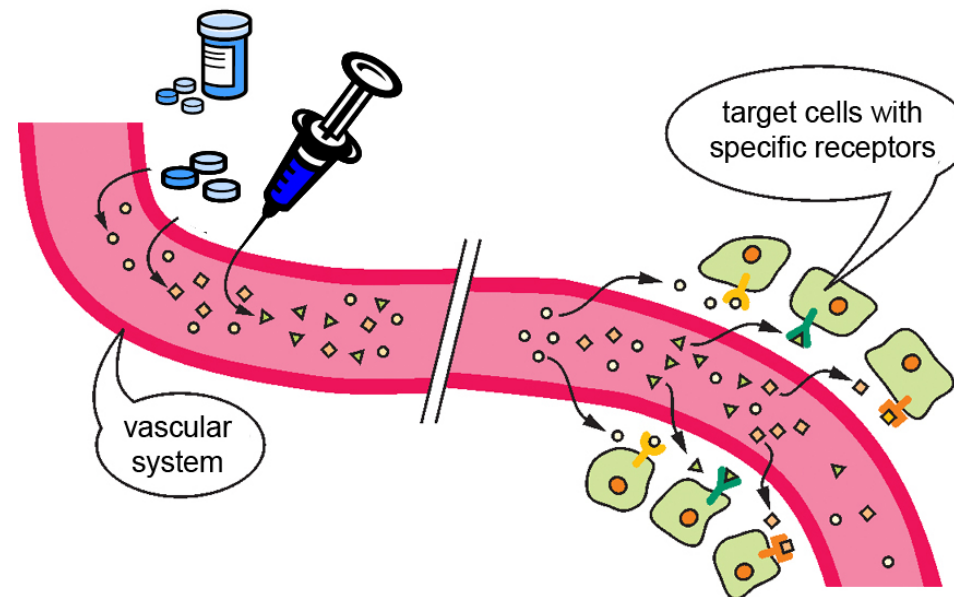
- Anabolic means “to build up”
- Andro + genic means “male” + “to produce”
- Steroids are a kind of lipid molecules



- Endogenous versus exogenous steroids
- Example: testosterone
- Medical purpose: muscle dystrophy

## Anabolic steroids abuse and sports?

- “Build-up” of muscles and improves regeneration



- But: steroids do not lead to a muscle growth directly!
- But: physiologically the muscles are not prepared for such a growth

Müller-Esterl: Biochemie, 2004  
© Spektrum Akademischer Verlag, Heidelberg

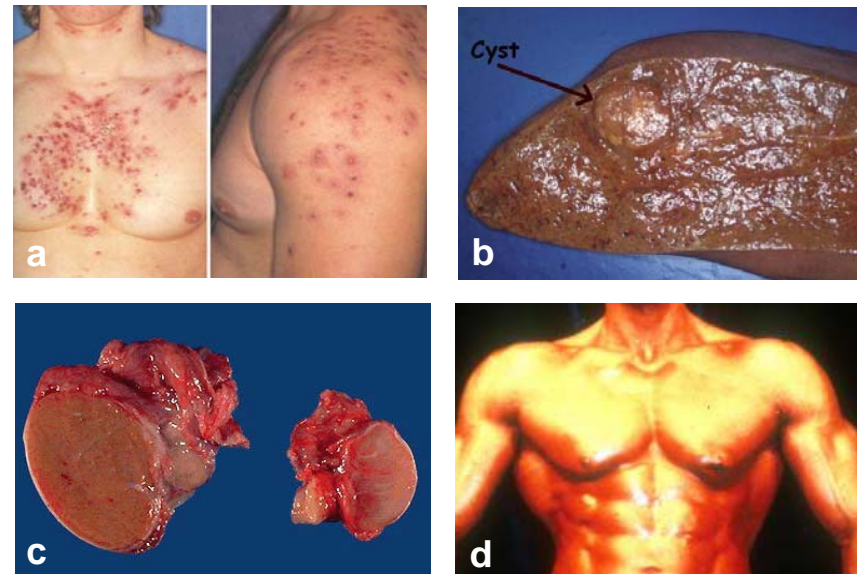


## Which side effects appear by an abuse?

- Male abusers: getting more female
- Female abusers: getting more male

### Further side effects:

- Acne (*a*)
- Liver cysts (*b*)
- Shrinking of the testis (*c*)
- Gynaecomastia (*d*)
- Degeneration of skeletal system
- Cardiovascular disturbances
- Deepening of the voice (*women*)
- Beard growth (*women*)
- Go bald (*men*)
- Increased aggressiveness (*roid-rage*)



(a) Melnik, Jansen & Grabbe (2007): J Dtsch Dermatol Ges. 5 (2):110-117. © by courtesy of Wiley-Blackwell  
(b, c) Kistler (2006): Dissertation, LMU, München  
(d) Prof. Dr. F. Beuker, Düsseldorf



## Summary & keywords to know

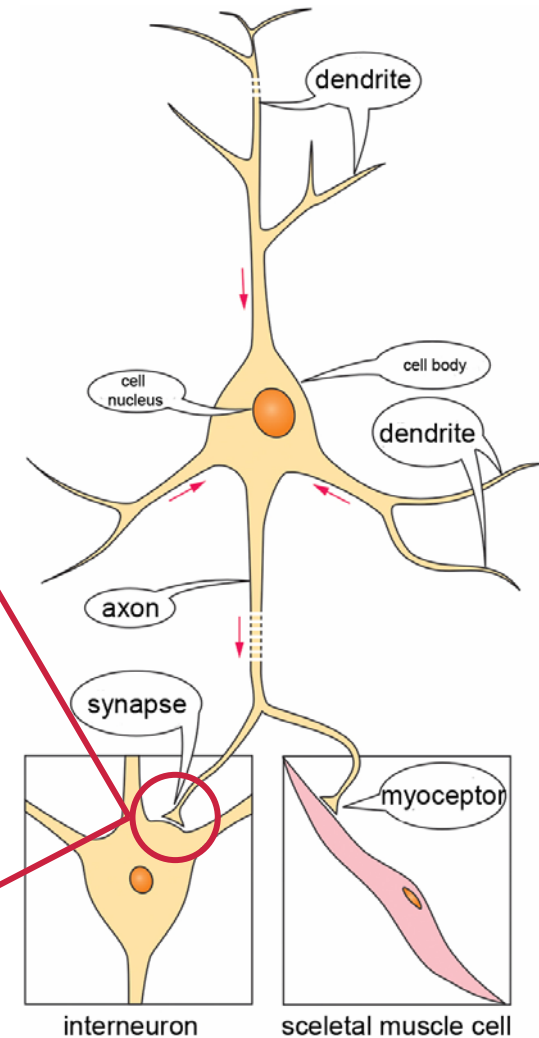
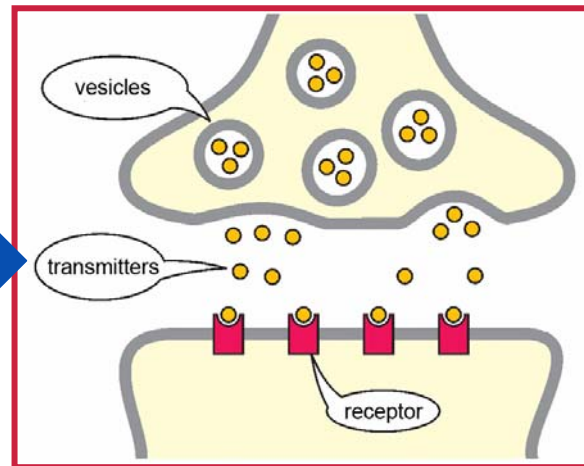
- **AAS are hormones**
- **AAS enhance the protein metabolism**
- **Anabolic means “to build-up” muscle proteins**
- **Androgen abuse means to masculinise (women) or feminise (men)**
- **They may have severe health side effects**
- **Steroids do not replace any training session!**



## What are stimulants?

- Affect the central nervous system
- Increase of the heart rate, breathing rate and brain function

Stimulants leading to an increased release of transmitters

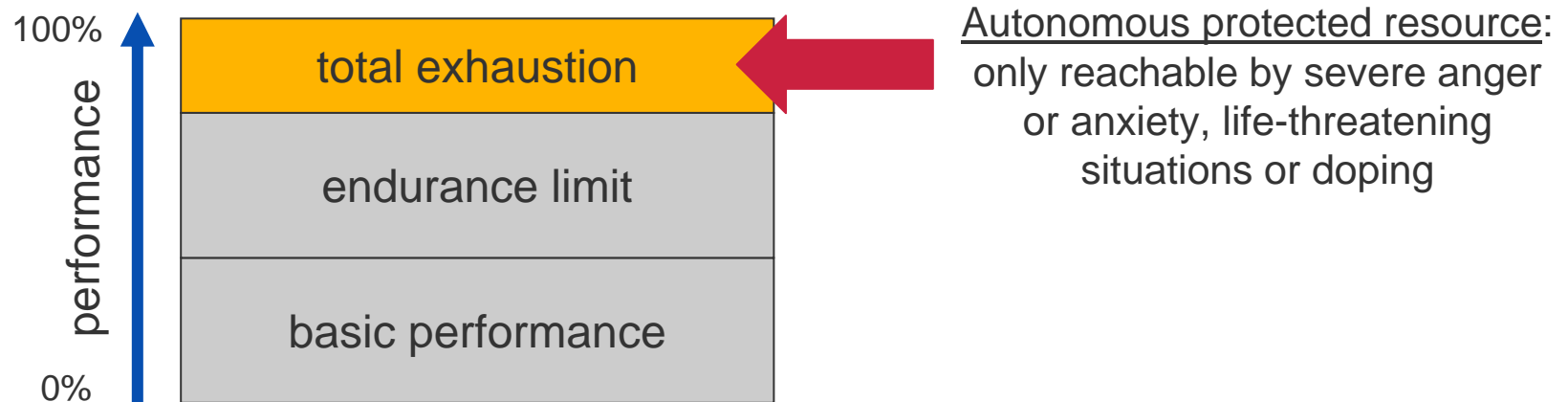


- Medical purpose: relaxing bronchi and cold medicine



## Why abuse stimulants in sports?

- Increases alertness, competitiveness and aggression
- Reduces tiredness and less sensitivity to pain



- But: no direct increase of physical performance!



## What are the health hazards of stimulants?

### Psychological disturbances:

- Addiction or depression

### Physiological effects:

- Dysregulation of the body temperature
- Loss of appetite and sleep
- Hallucinations
- Body trembling, restlessness, agitation, tension
- Cardiac arrhythmia



I. Normal Rate and Rhythm



II. Cardiac Arrhythmia

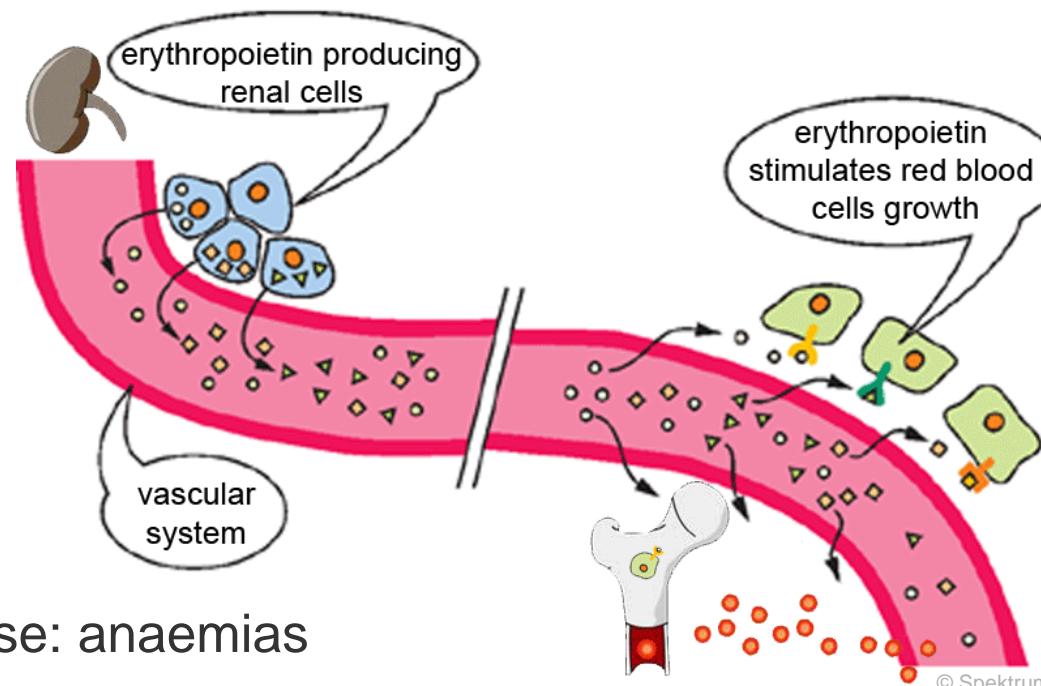


## Summary & keywords to know

- **Stimulants affect the nervous system**
- **They lead to an excitation of the brain and the body and an increase of competitiveness and aggression**
- **They cause less sensitivity to pain**
- **Side effects appear on a wide range from acute stress symptoms to addiction**
- **Side effects appear on psychological and/or physiological basis**

## What is EPO?

- Erythropoietin is a hormone
- It stimulates synthesis of the red blood cells
- Red blood cells carry oxygen to the tissues



- Medical purpose: anaemias

Müller-Esterl: Biochemie, 2004  
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## Why abuse EPO in sports?

- Increase of red blood cells
- Increase of tissue oxygenation
- Secure endurance performance

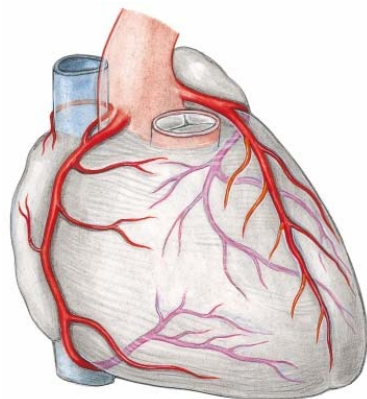


Nordic skier Eero Mäntyranta

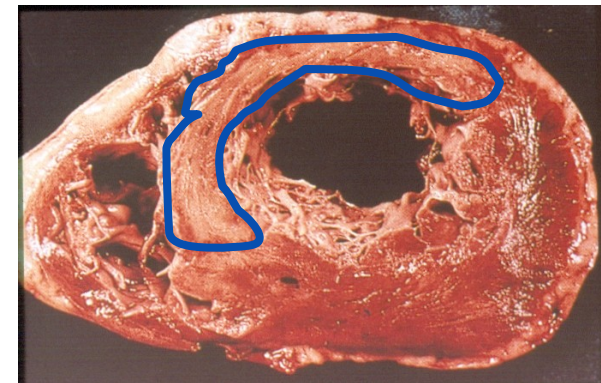
- Legal alternative: high altitude training!

## What are the health hazards of EPO?

- Increases blood viscosity
- Increases risk of high blood pressure (arterial hypertension)
- Increases risk of blood clots (thromboembolic events), e.g. infarct, stroke



Blood vessels supplying the heart muscle could be closed by a clot (thrombus)  
leading to infarction



Sobotta: Atlas der Anatomie des Menschen  
©Elsevier GmbH, Urban & Fischer Verlag München

- **Be aware: EPO-abuse can be strongly life-threatening!**



## Summary & keywords to know

- **Erythropoietin is a hormone**
- **Increases the synthesis of erythrocytes → O<sub>2</sub> transport ↑**
- **Oxygen is needed to secure endurance performance**
- **Legal alternative is high altitude training**
- **Blood clots (thromboembolic events) may occur in the lung, brain and heart**



## What is blood doping?

- Illegal method of manipulation
- Direct enhancement of red blood cells and thereby oxygen transfer

### Two different methods:

- Collect own blood and reinject later
- Taking blood of a donor and reinject if required

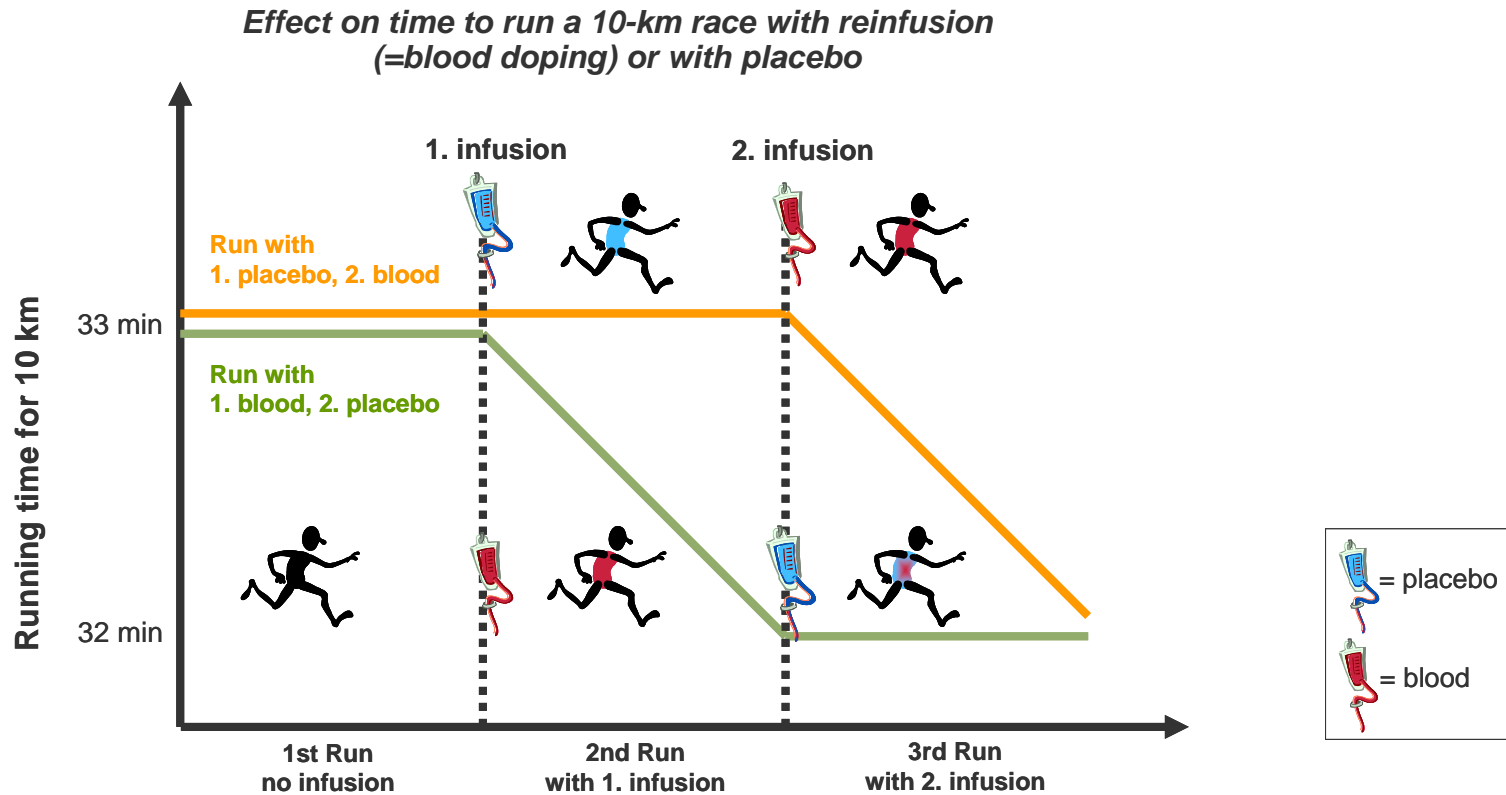


Medical purpose: treatment of enormous blood losses



## Why abuse blood doping in sports?

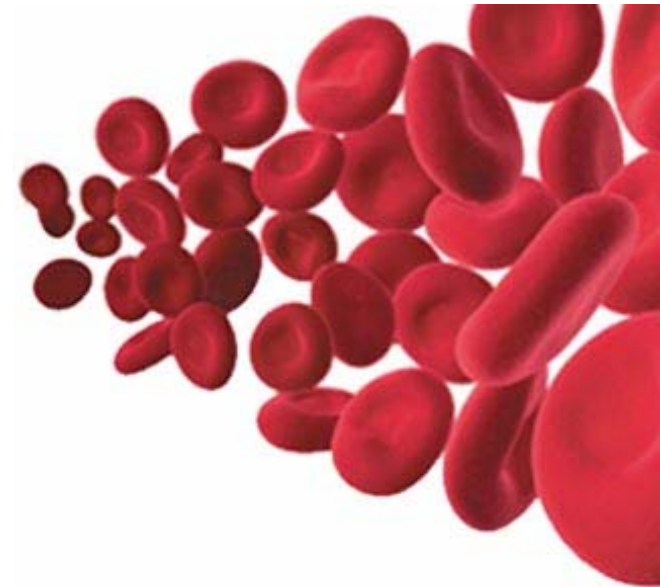
- Increases endurance-performance
- Comparable effects to erythropoietin but with an immediate effect





## What are the health hazards of blood doping?

- Increased blood pressure
- Increased risk of thrombosis
- Risk of a transfusion accident by allergies or incompatibilities
- Risk of severe infections like hepatitis or HIV





## Summary & keywords to know

- **Blood doping enhances oxygen transfer by infusion of additional red blood cells**
- **There are comparable effects to the abuse of erythropoietin but with an immediate effect**
- **Health risks of thrombosis and infections**



## What are nutritional supplements?

- In the body naturally existing substances, that are additionally consumed to normal daily nutrition
  - E.g. glucose, minerals, vitamins or trace elements
  - Partly essential for the growth and development
- 
- Medical purpose: deficiencies in the body due to malnutrition and illnesses





## Why use nutritional supplements in sports?

- To perform the intensity and duration of their sports some competitive athletes need extremely high calorie intake levels, that cannot be covered by normal daily nutrition
- Critical substances may be some vitamins of the B group in vegetarian athletes
  
- But: a well-balanced diet is much better than any nutritional supplementation
- But: intake levels have to be taken into account ('overdosage')





## What are the doping risks of nutritional supplements?

- “Unlabelled” ingredients that can be doping substances
- Most detected unlabeled substances are steroids and stimulants

IOC nutritional supplement analysis			
country	products	“unlabelled” drug	percentage
NL	31	8	26%
UK	37	7	19%
USA	240	45	19%
I	35	5	14%
D	129	15	12%

The International Olympic Committee Medical Commission, Lausanne, Switzerland (2002)



- Possible side effects depend on the “unlabelled” substances



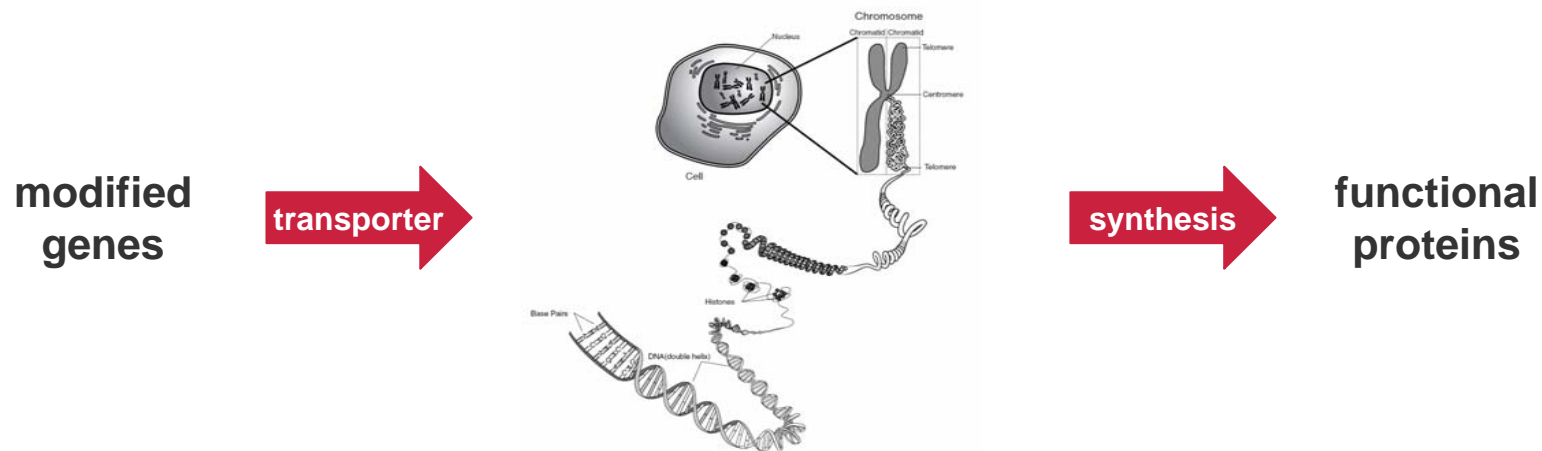
## Summary & keywords to know

- **Supplements are rarely necessary if an adequate nutrition is practised**
- **Enormous risk of positive doping testing due to “unlabelled” substances**
- **Possible health side effects are based on the respective “unlabelled” substance**



## What is gene therapy?

- genes code the construction plan of proteins: the tools and components of the body
- gene therapy tries to change the information on genes



- Medical purpose: correcting defective genes responsible for disease development like hereditary diseases
- But: abuse of the therapeutic idea for sport purposes must be feared

From: Talking Glossary, The National Human Genome Research Institute

## Why abuse gene doping in sports?

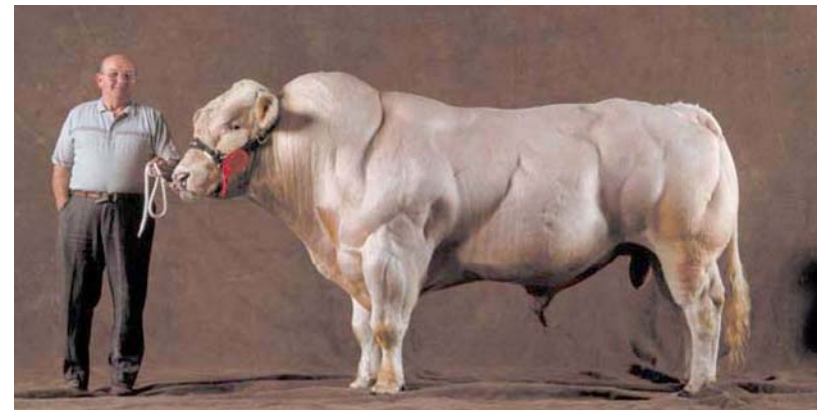
### potential aims:

- increased erythropoietin production    ➡ endurance performance ↑
- stimulation of muscle growth factor    ➡ power ↑, speed ↑

**Myostatin-mutation-baby<sup>1</sup>**



**Raised myostatin-mutation-bull**



- Abuse in sports currently not known!

<sup>1</sup>Schülke et al. (2004): N Engl J Med, p2682-2688.  
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## What are potential health hazards of gene doping?

Results from clinical trials for gene therapy methods reported that the following problems can appear:

- cancer,
- multiple organ failure and
- other strongly life-threatening events

Further risks are totally unknown...

...due to the sparse studies and publications

...and thus the biomedical side effects of gene therapy  
are uncontrollable!



## Summary & keywords to know

- **Gene therapy aims to change the information of defective/mutated selective genes**
- **Ideas of an abuse in sports are directed towards an influence of an enhanced oxygen transfer or an increased muscle fibre growth**
- **Unknown and thus uncontrollable biomedical side effects of gene therapy**



## What can we do?

- **LEARN** to train your body right!
- **KNOW** the health risks of doping!
- **BE** fair and a role model!
- **REFUSE** doping offers!
- **DEMONSTRATE** a doping-free sport!



## Project partners



Medical University of Plovdiv, Bulgaria  
Prof. Katerina Georgieva



Technische Universität München, Germany  
Prof. Horst Michna



Aristotle University of Thessaloniki, Greece  
Prof. Asterios Deligiannis



Institute of Sport, Warsaw, Poland  
Prof. Ryszard Grucza



University of Extremadura, Spain  
Prof. Eduardo Ortega Rincon