

The Science  
of  
**Cold Weather Operations**

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NORWEGIAN  
ARMED FORCES





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PhD - temperature physiology  
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A soldier in a white winter uniform is shown from the back, wearing a blindfold and carrying a rifle slung over their shoulder. They are standing in a snowy environment. The text is overlaid on the image.

**Any opinions, findings, and conclusions or recommendations expressed in this material are mine and do not necessarily reflect the view of the Norwegian Armed Forces.**

A person wearing a white long-sleeved shirt and pants, a white blindfold, and a white headband is kneeling in a snowy environment. They are carrying a large, tan-colored rifle with a scope and a magazine on their back. A tan tactical bag is slung over their shoulder. To their right is a white inflatable boat with the brand name "PULKEN" visible on its side. The boat is secured with black straps and is partially submerged in the snow. The background is a vast, flat, white expanse of snow.

No affiliation with any companies  
relevant to this









37.5°C



Time







37.5°C



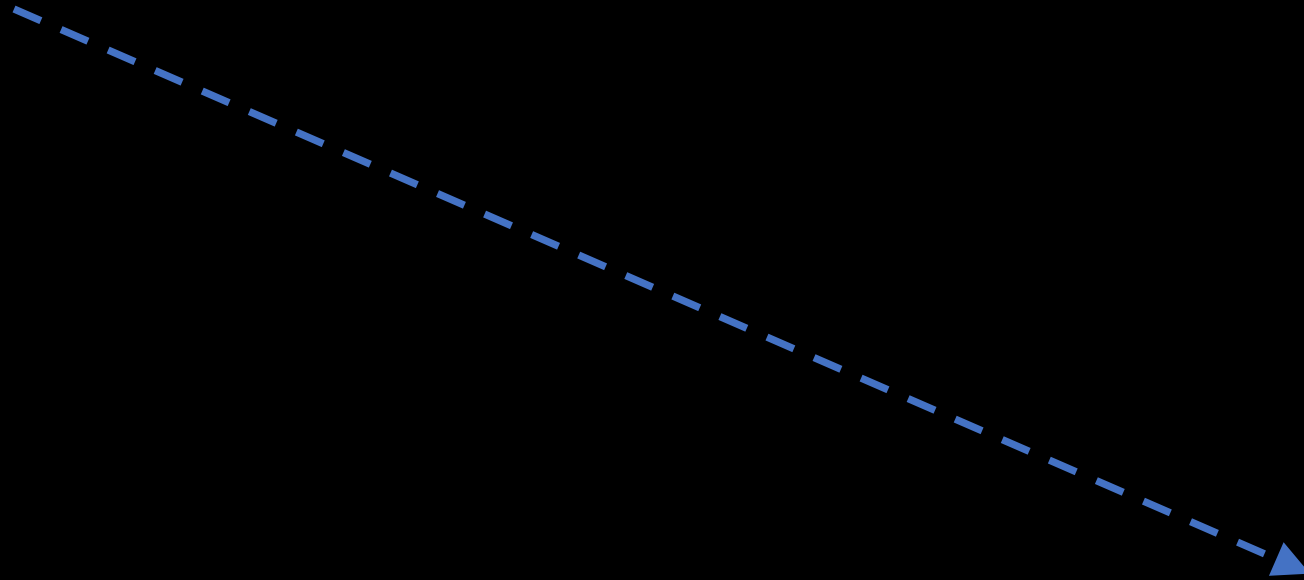
35.0°C



Time



37.5°C



35.0°C



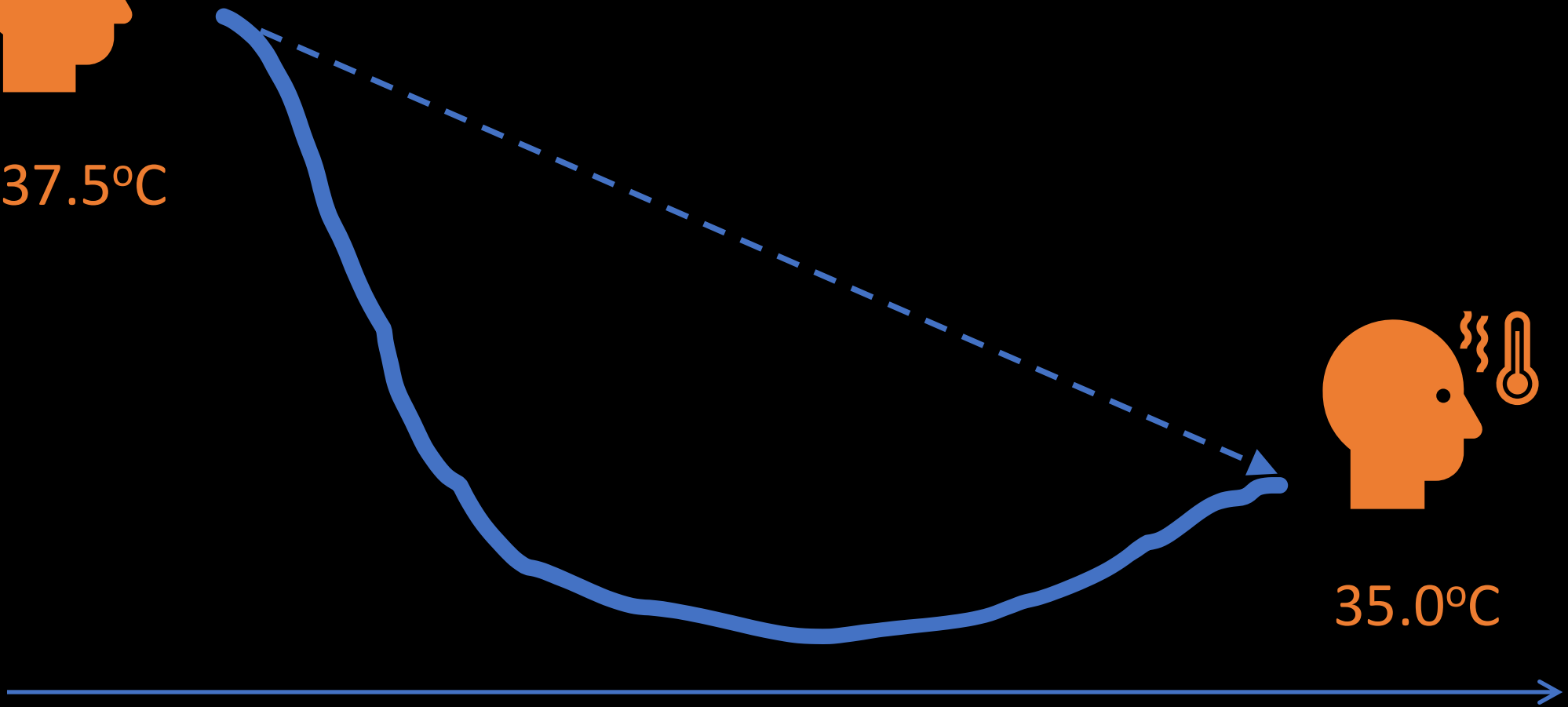
Time



37.5°C



35.0°C



Time



37.5°C



37.5°C



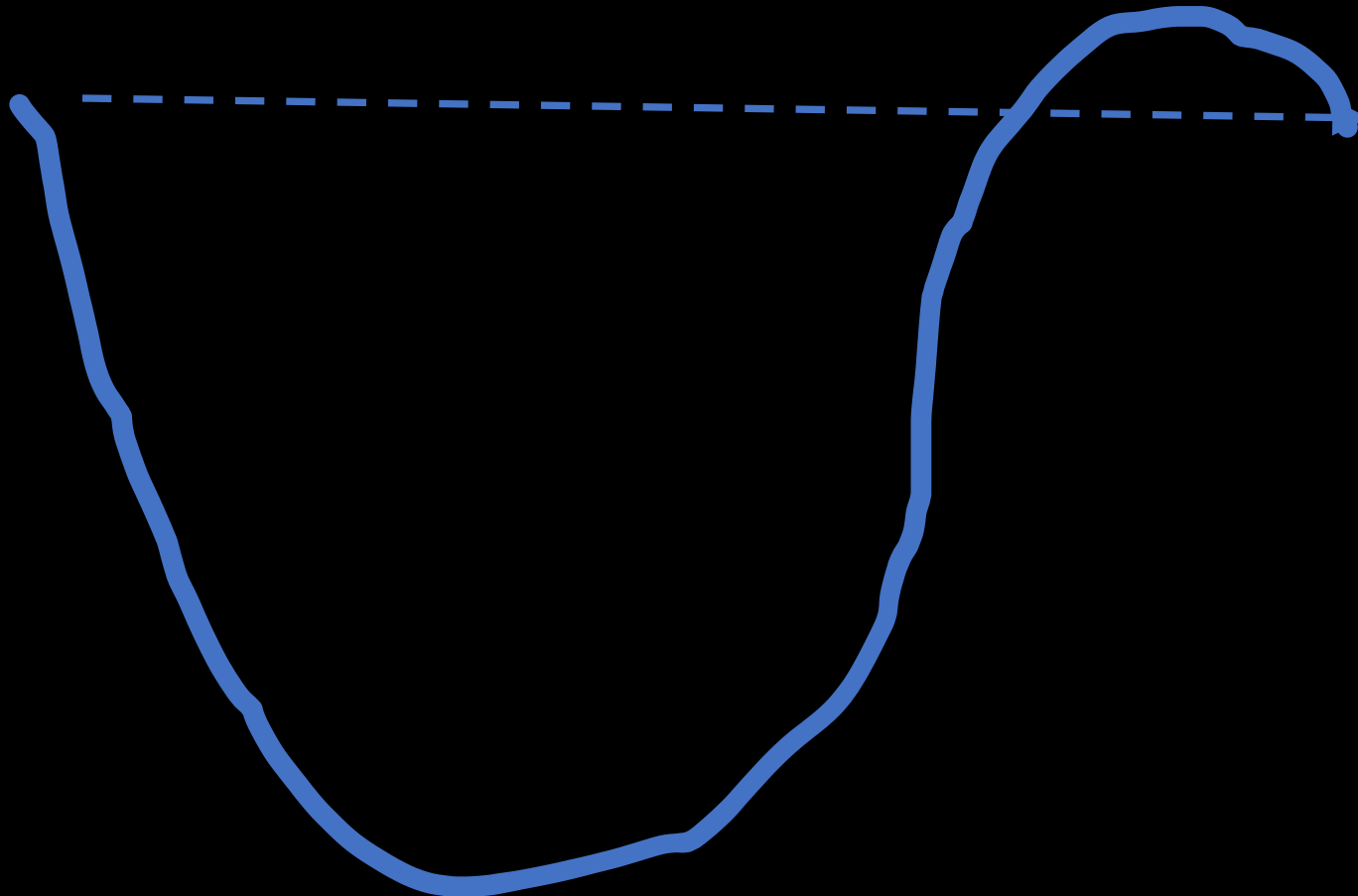
Time



37.5°C



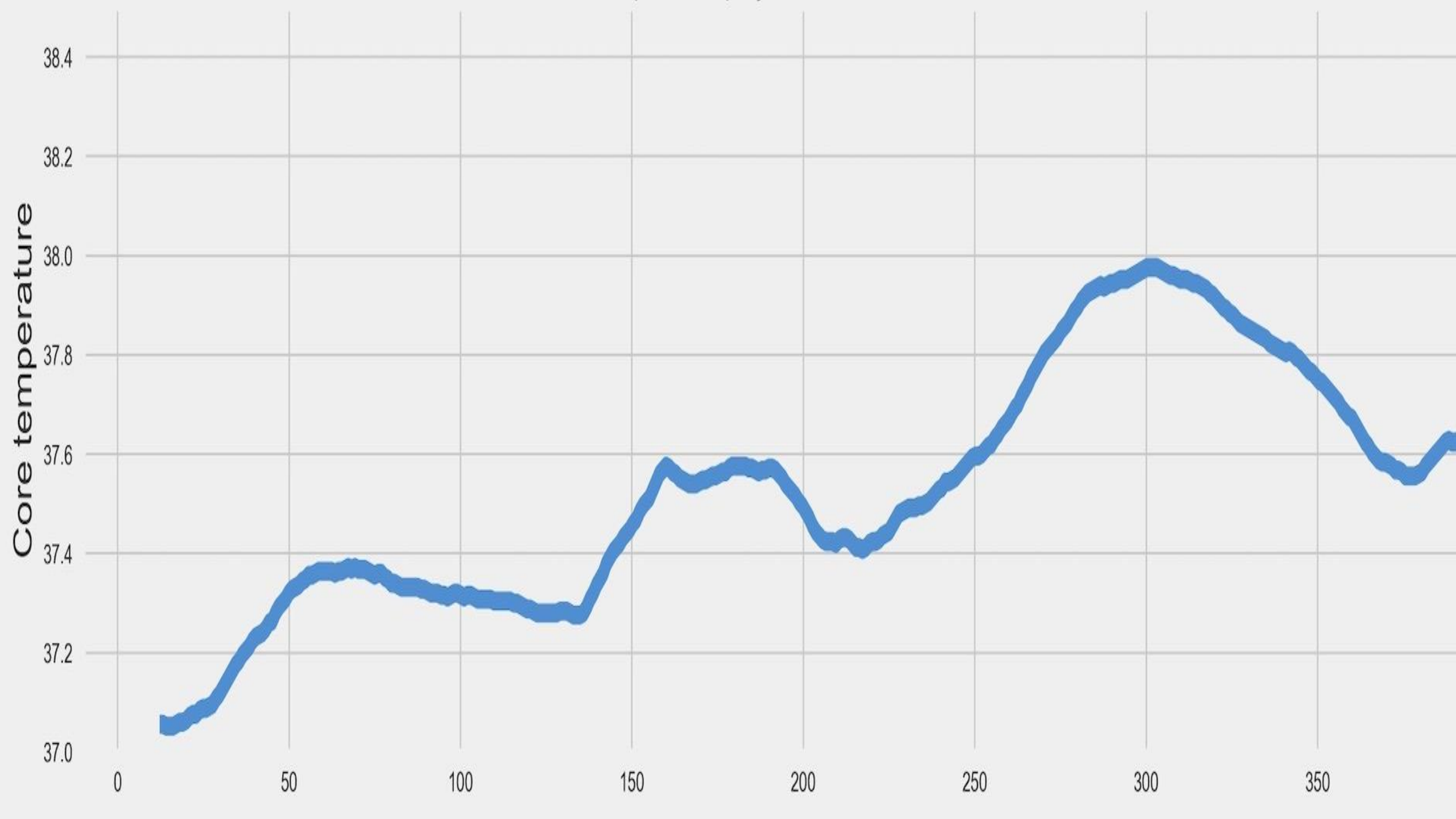
37.5°C



Time

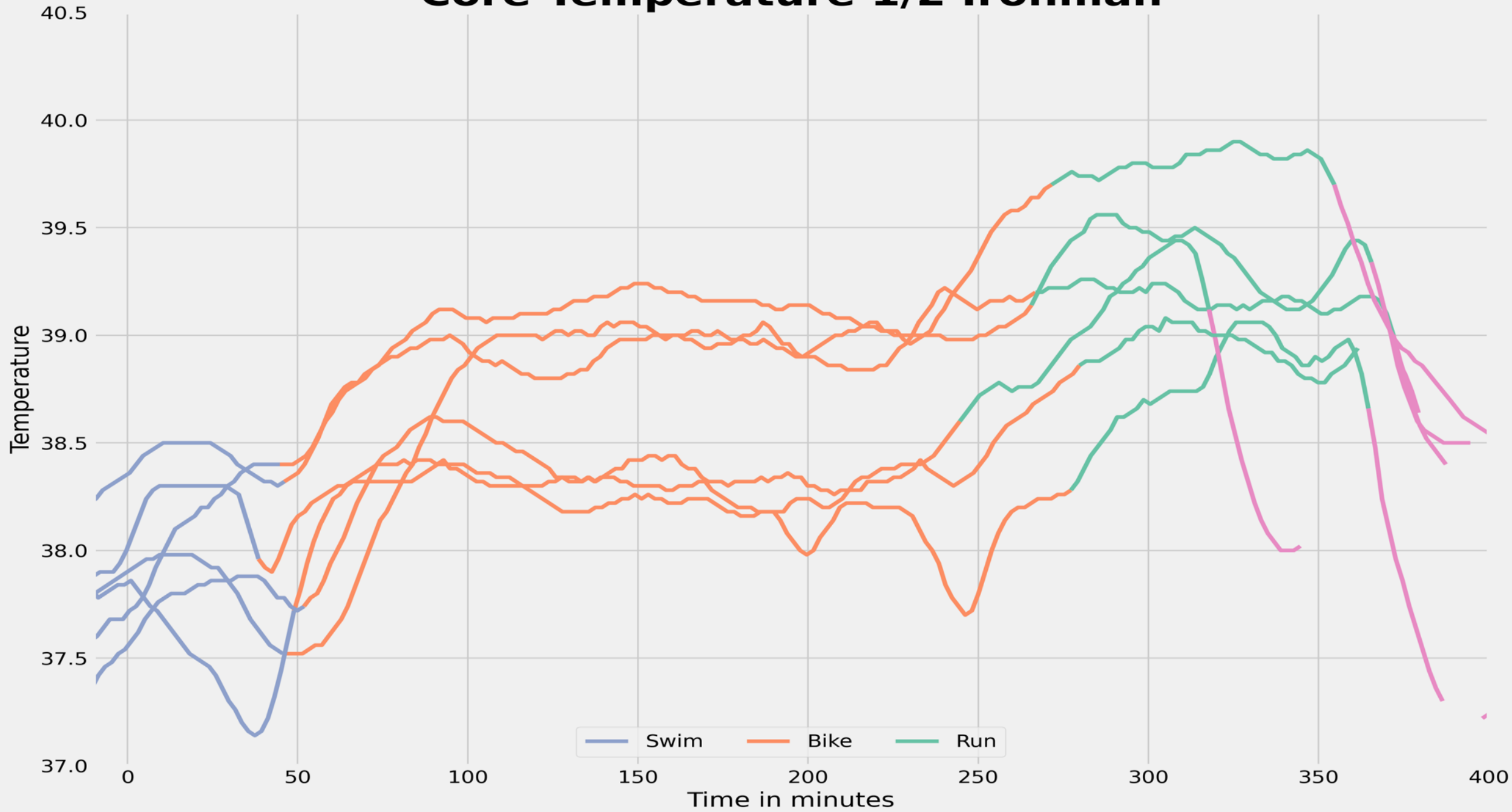


Core temperature

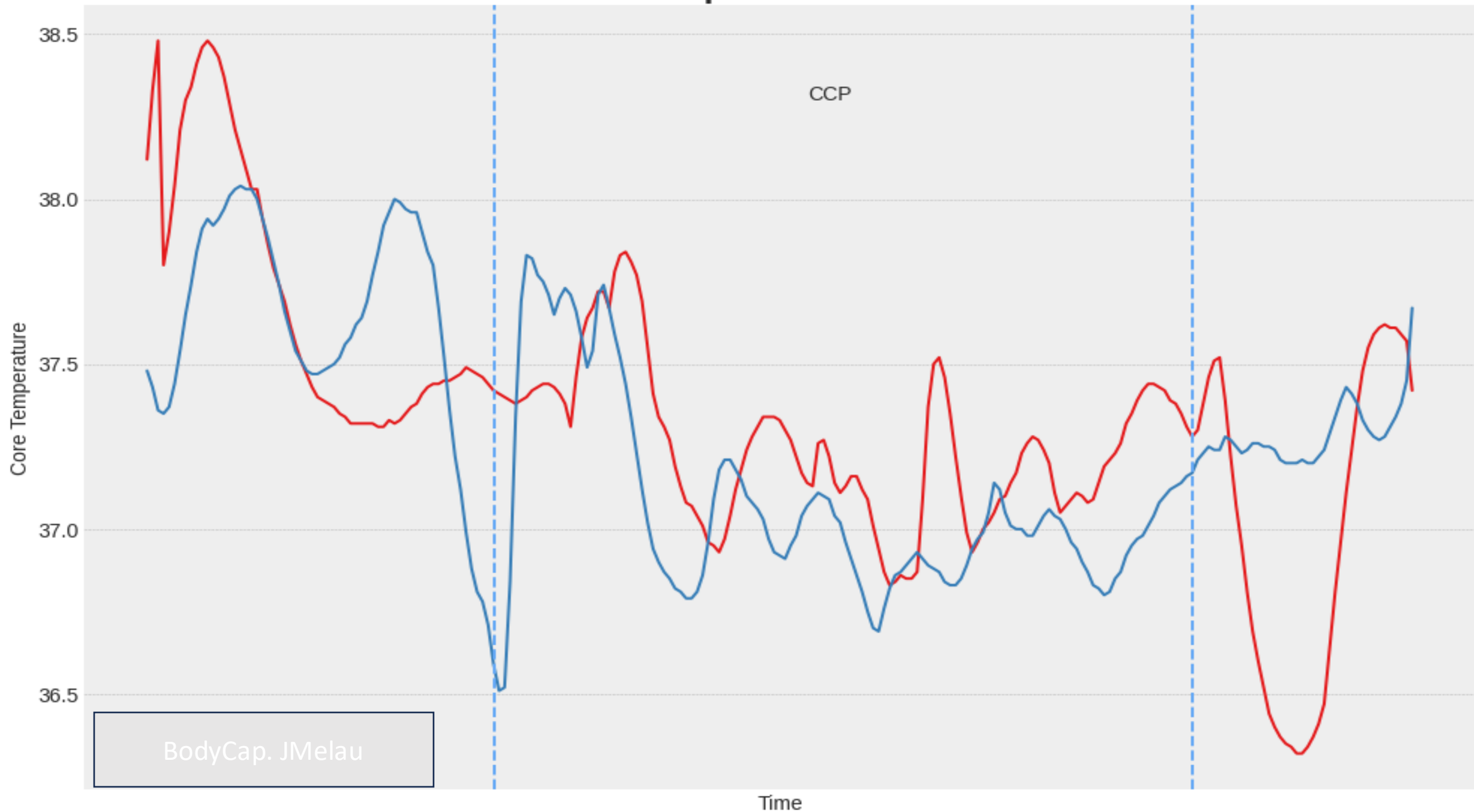




# Core Temperature 1/2 Ironman



# Core Temperature PFC case



# Basal temperature physiology



# Basal temperature physiology

A black and white photograph of a woman running on a paved path along a beach. She is wearing a dark tank top and leggings. The background shows the ocean waves and a rocky shoreline. The image is overlaid with several text boxes that explain physiological responses to temperature changes.

To cold?

To varm?

Blood vessels in the skin contracts

Blood vessels in the skin dillates

Shivering

Sweat

Heat transfer

Convection  
Conduction  
Radiation  
Evaporation



Convection  
Conduction  
Radiation

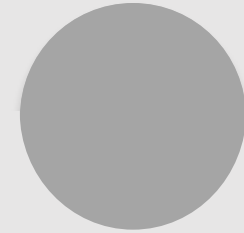
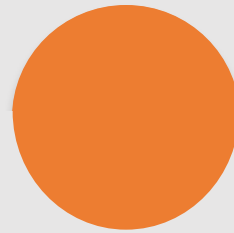
**Evaporation**



# Heat transfer



Normal

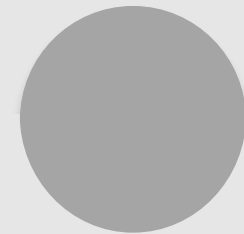
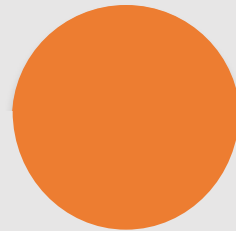




# Heat transfer



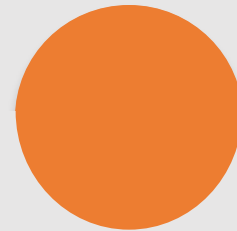
Normal



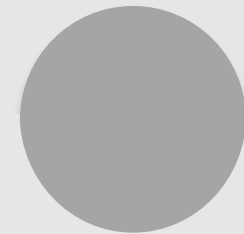
# Heat transfer



Normal



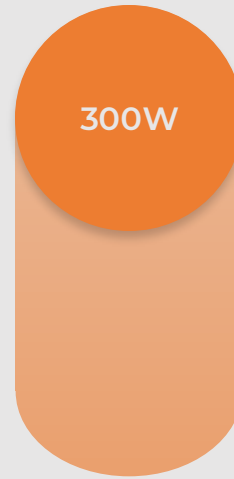
Shivering



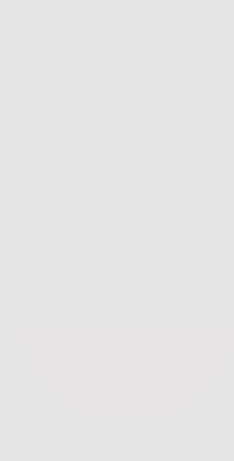
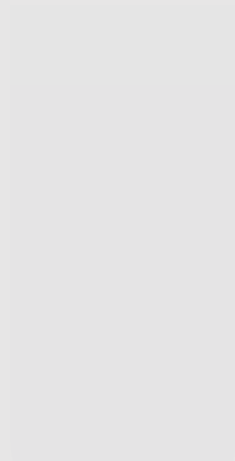
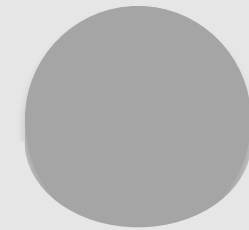
# Heat transfer



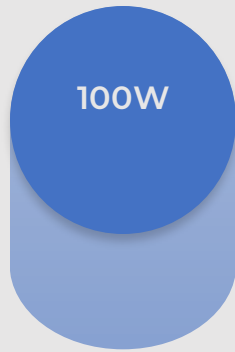
Normal



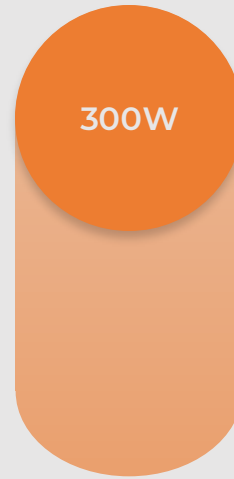
Shivering



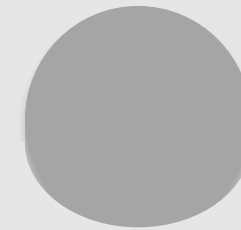
# Heat transfer



Normal

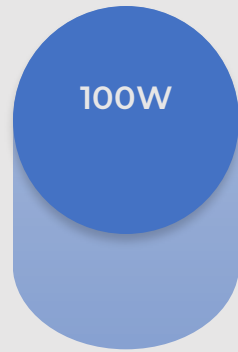


Shivering

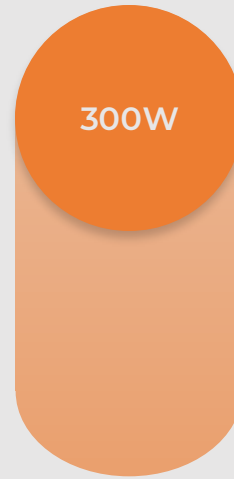


Evaporation

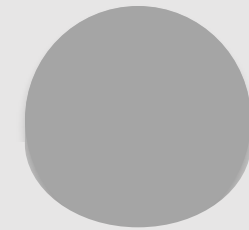
# Heat transfer



Normal



Shivering



Evaporation

**-2500W**

Remove wet clothing







# The swim

- 10.000m in open sea
- 5°C water, 2.8°C air
- Zero wind.
- Drysuit, hood and gloves
- Fins and dive mask



# *Impact of a 10 000m cold water swim on Norwegian Naval Special Forces recruits*



Photo: Torgeir Haugaard / Forsvaret

Core  
temperature

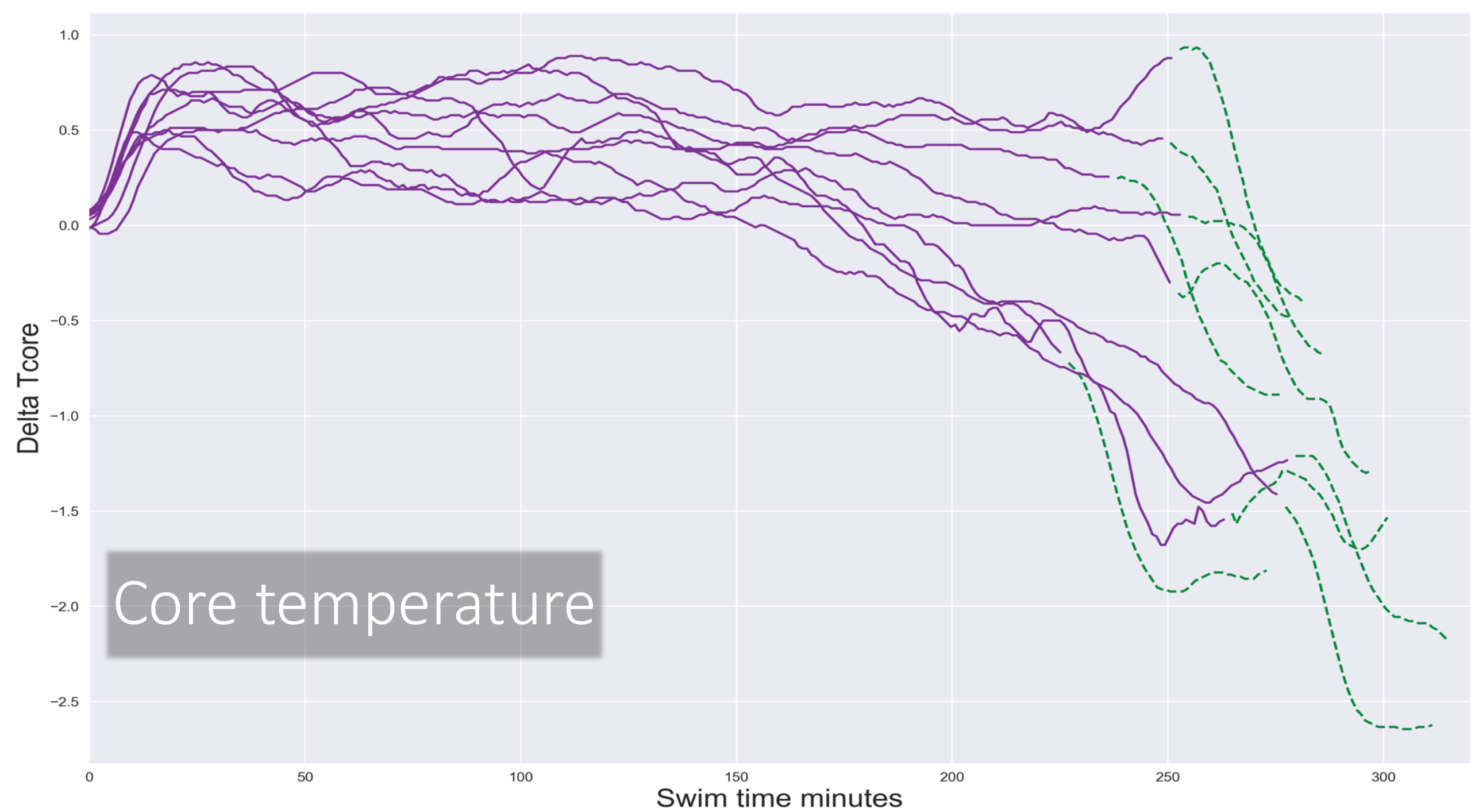
Skin  
temperature

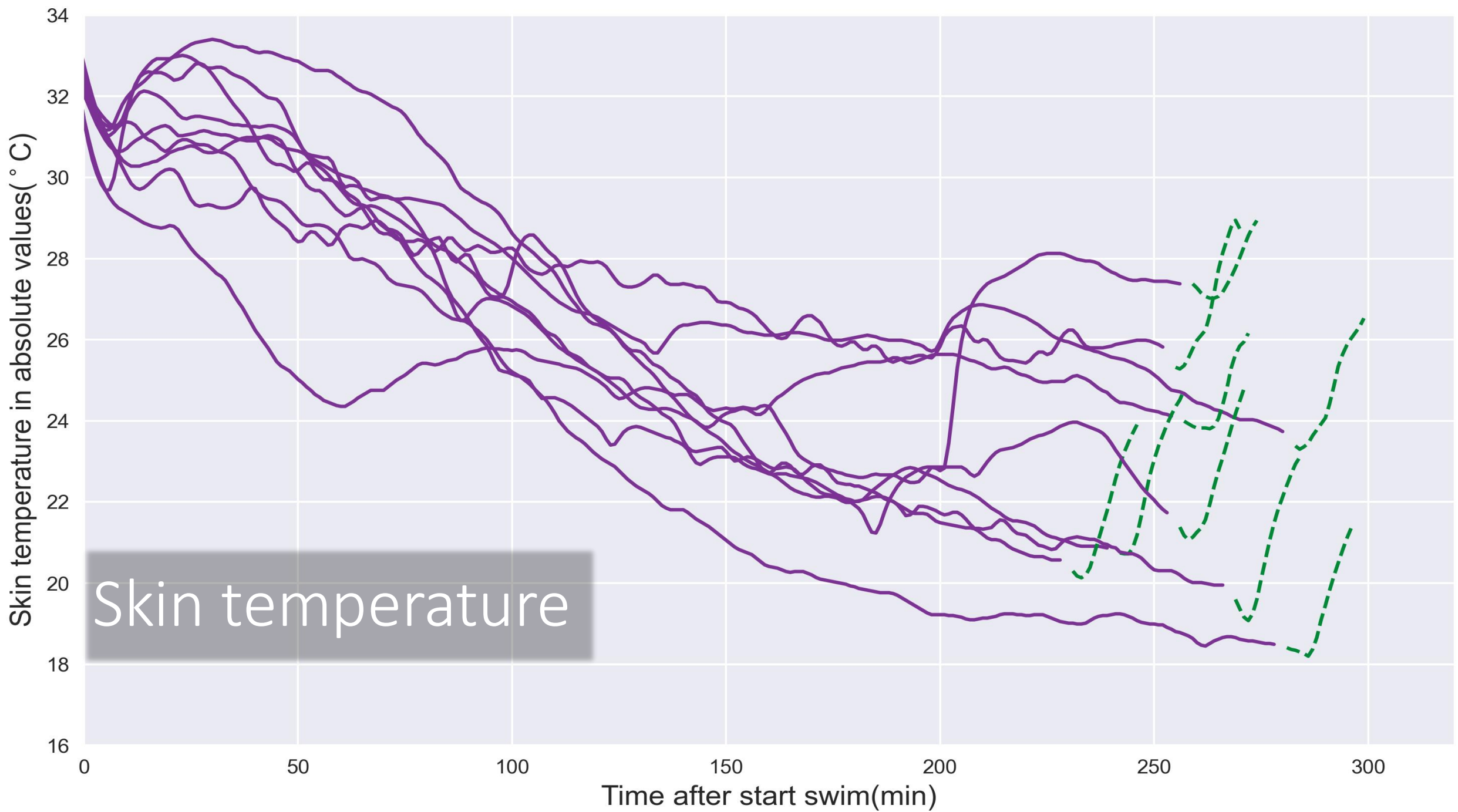
Blood samples  
(CK, Testo,  
CRP, Cortisol)

Force and  
power

Dexterity

STROOP





Skin temperature

A red plastic bucket lid is shown from a top-down perspective, resting on a white, snow-covered surface. The lid is circular and has several pieces of hardware scattered on its surface. At the top, there is a black, curved handle. Below it, there are two silver-colored washers. In the center, there is a silver-colored nut. To the right of the nut, there is a silver-colored L-shaped bracket. Below the bracket, there are two silver-colored bolts. The background is a bright, snowy surface with some shadows. A wooden pole is visible on the right side of the frame, extending from the snow towards the bucket. The overall scene suggests a field or outdoor setting in winter.

Washer, nut and bolt test

Dexterity



Photo: Olav Standal Tangen

What is the best hypothermia kit?



There is **NO** best hypothermia kit!





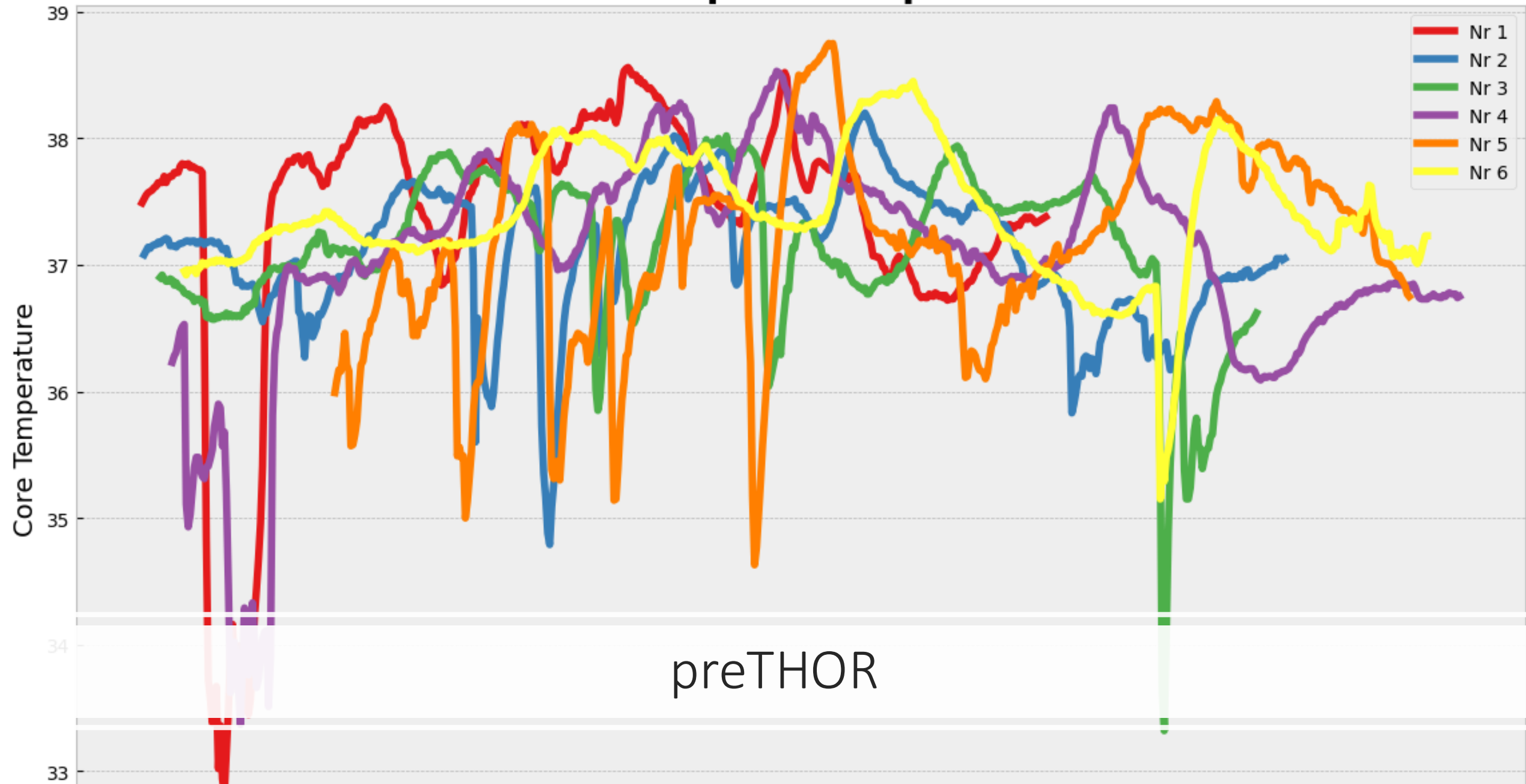




preTHOR



# Core Temperature preTHOR



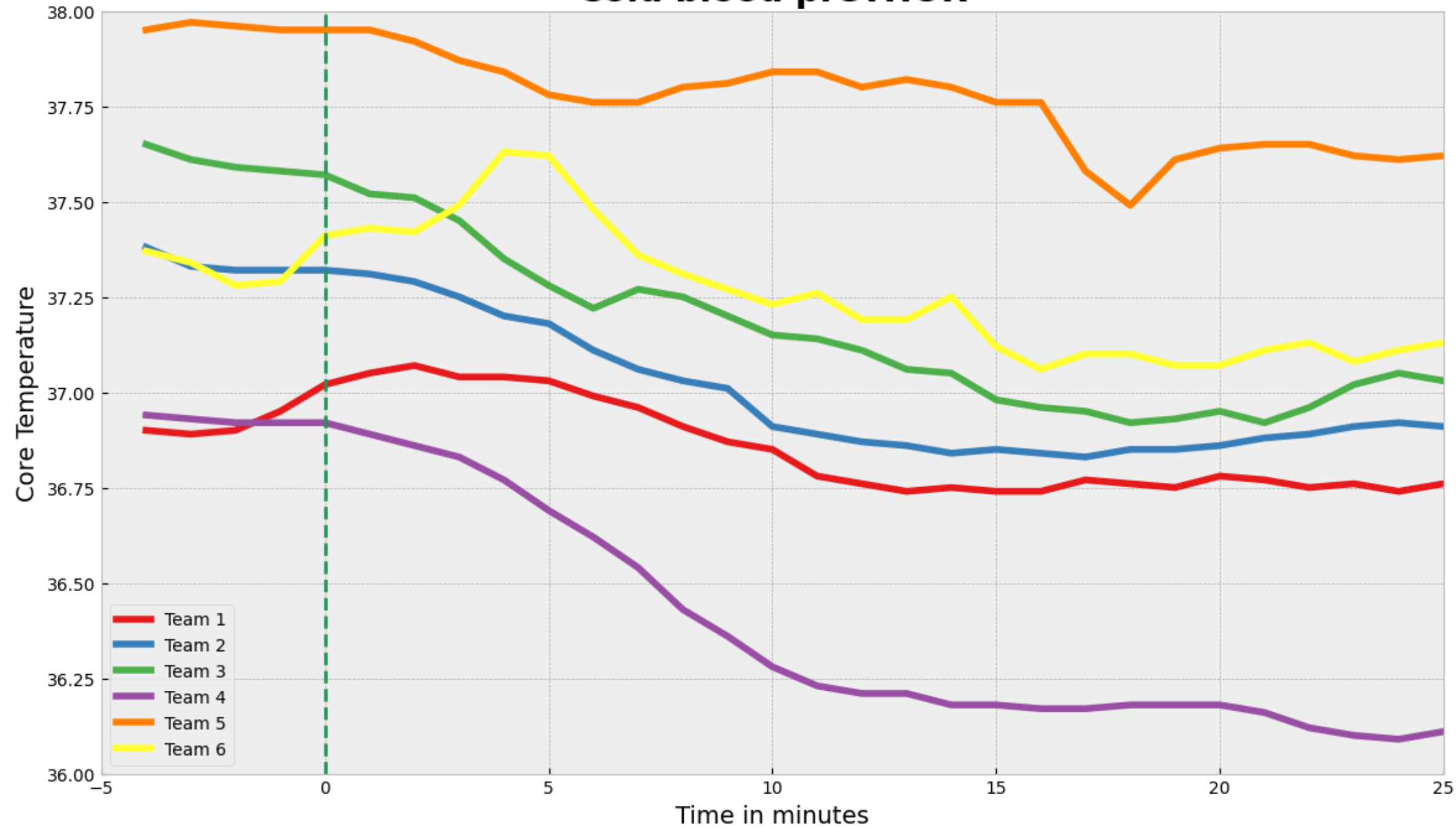
preTHOR



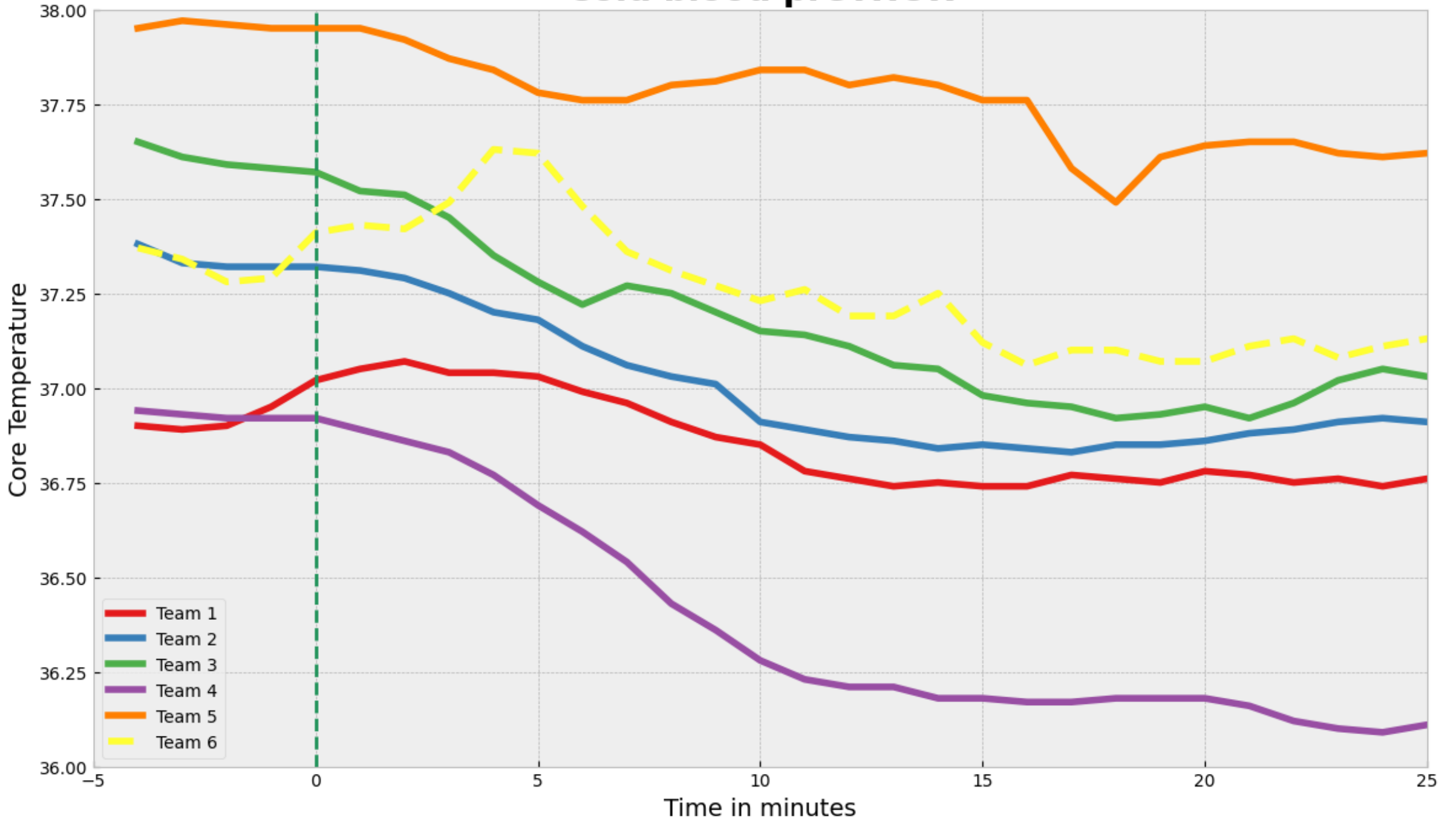
## preTHOR

- Outside 25°C (77°F)
- In container -24°C (-11°F)

# Cold blood preTHOR



# Cold blood preTHOR



# Skin temperature

A new usable tool?





How to prevent hypothermia in a trauma patient?









Vapor barrier



Vapor barrier

# Isolation Layer



Vapor barrier  
Isolation Layer

**Wind/Waterproof layer**



Vapor barrier  
Isolation Layer  
Wind/Waterproof layer

# External insulation



Vapor barrier  
Isolation Layer  
Wind/Waterproof layer  
External insulation (Sleeping pad)

**Heat source**



Vapor barrier  
Isolation Layer  
Wind/Waterproof layer  
External insulation (Sleeping pad)  
Heat source





# Burrito Wrap





But it can't always be perfect

It's not about the gear - it is  
about knowledge and training!



It's not about the gear - it is  
about knowledge and training!

Please  
Tweet!



@jmelau

What is next?



Foto: Torbjørn Kjosvold/Forsvaret



NORWEGIAN  
ARMED FORCES



@jmela  
u

jmela@protonmail.c  
om



We need to talk about the Space Blanket









We need to to better!

M

COLD GEAR, HAEMOSTATIC AGENT

(H)

DEXTERITY, COLD PATIENT AND RESCUER, COLD INJURIES. LIMITED EXPOSURE = MISSED INJURIES

A

COLD GEAR, COLD AIR VENTILATION

R

CHEST SEAL ADDITIVITY AND FUNCTION

C

BATTERIES, COLD FLUIDS AND BLOOD

H

ALTERED CONSCIOUSNESS



# Shelter



