39th RCPT ANNUAL MEETING HYBRID Meeting

Heatstroke & Heat-related illness

Virissorn Wongsrichanalai M.D.

Division of Pulmonary and Critical Care Medicine

Department of Medicine

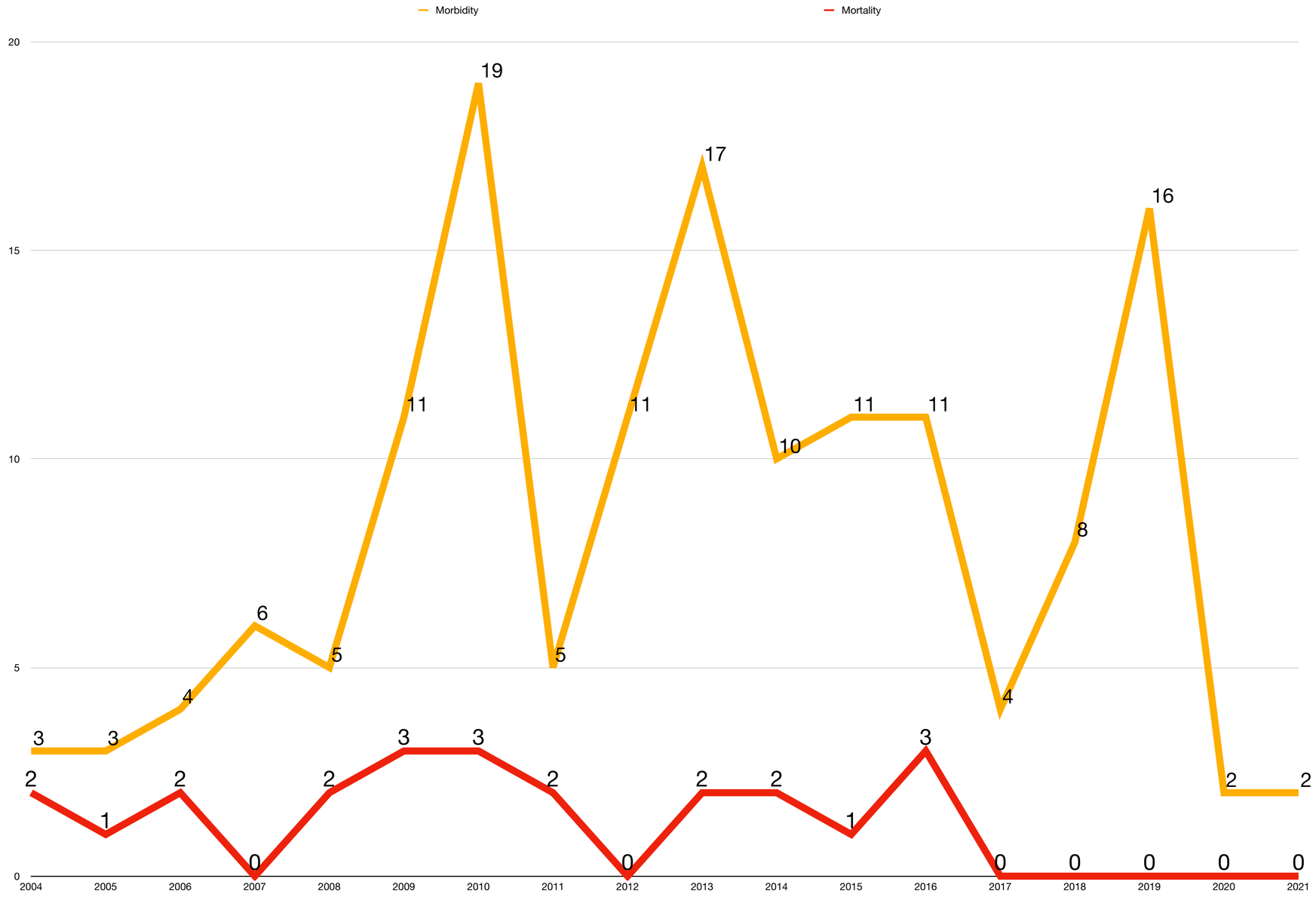
King Chulalongkorn Memorial Hospital

I have no conflict of interest

Outline

- Mechanism of heat on body
- Core temperature
- Pitfall in diagnosis
- Prehospital care
- Hospital management
- Pitfall in management

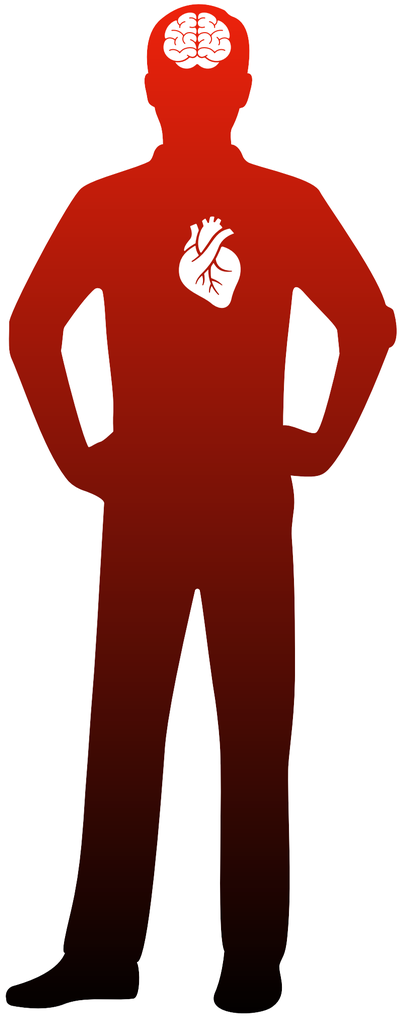
Morbidity & Mortality of EHS in RTA since 2004



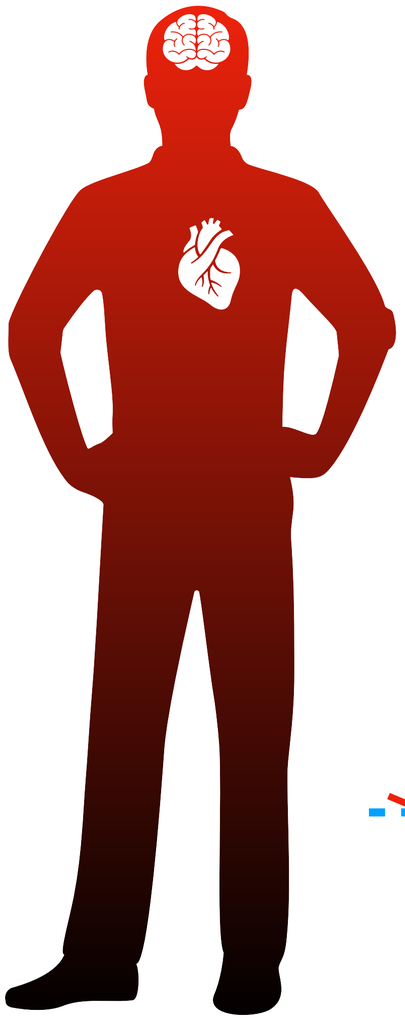
Heat & Human Body

1. **Heat transfer 4 mechanisms**
   - **Conduction**
   - **Convection**
   - **Evaporation**
   - **Radiation**

2. **Heat controlled center**
   1) **Preoptic Area of Hypothalamus (PAoH)**
   2) **Temperature is controlled with ANS and Behavior**

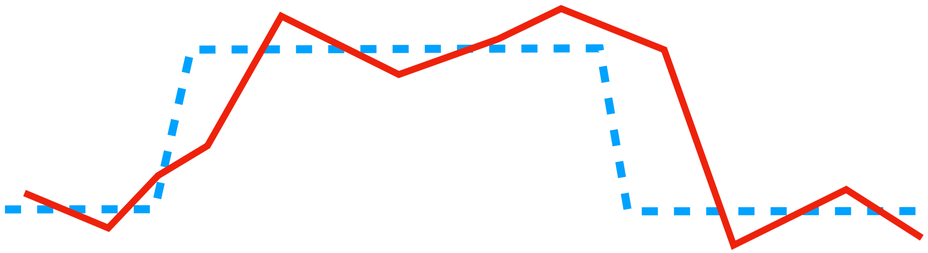


Heat & Human Body

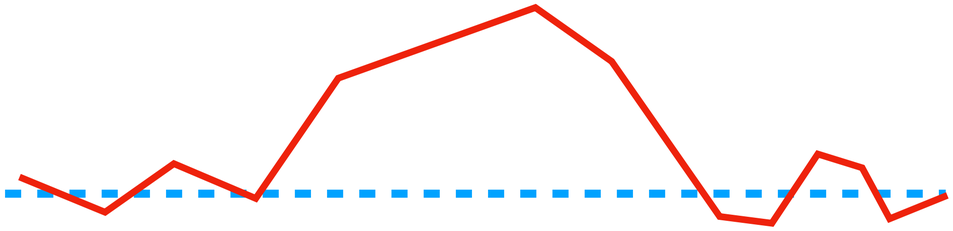


3. Core temperature (Tc) & Temperature set point (Tsp)

- **Core temperature from Rt. atrium**
- **Temperature set point at brain**
- **Different between fever & hyperthermia**



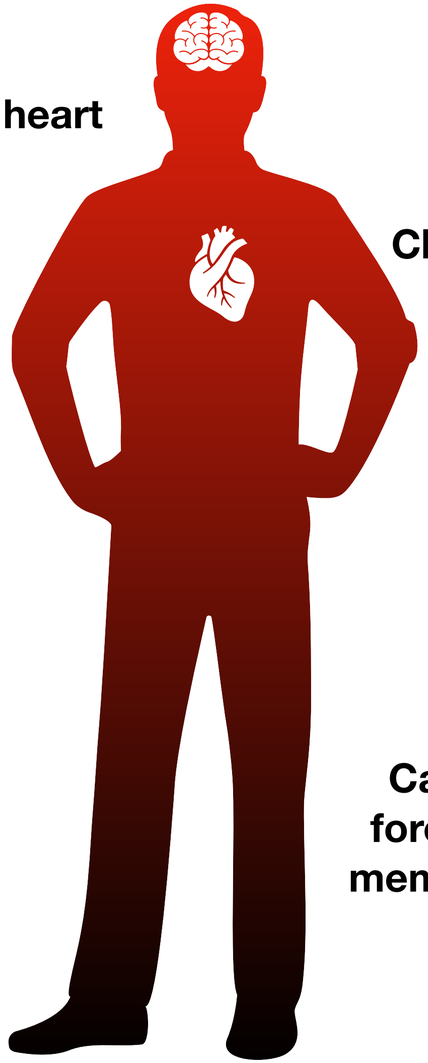
Fever



Hyperthermia

Core temperature (Tc)

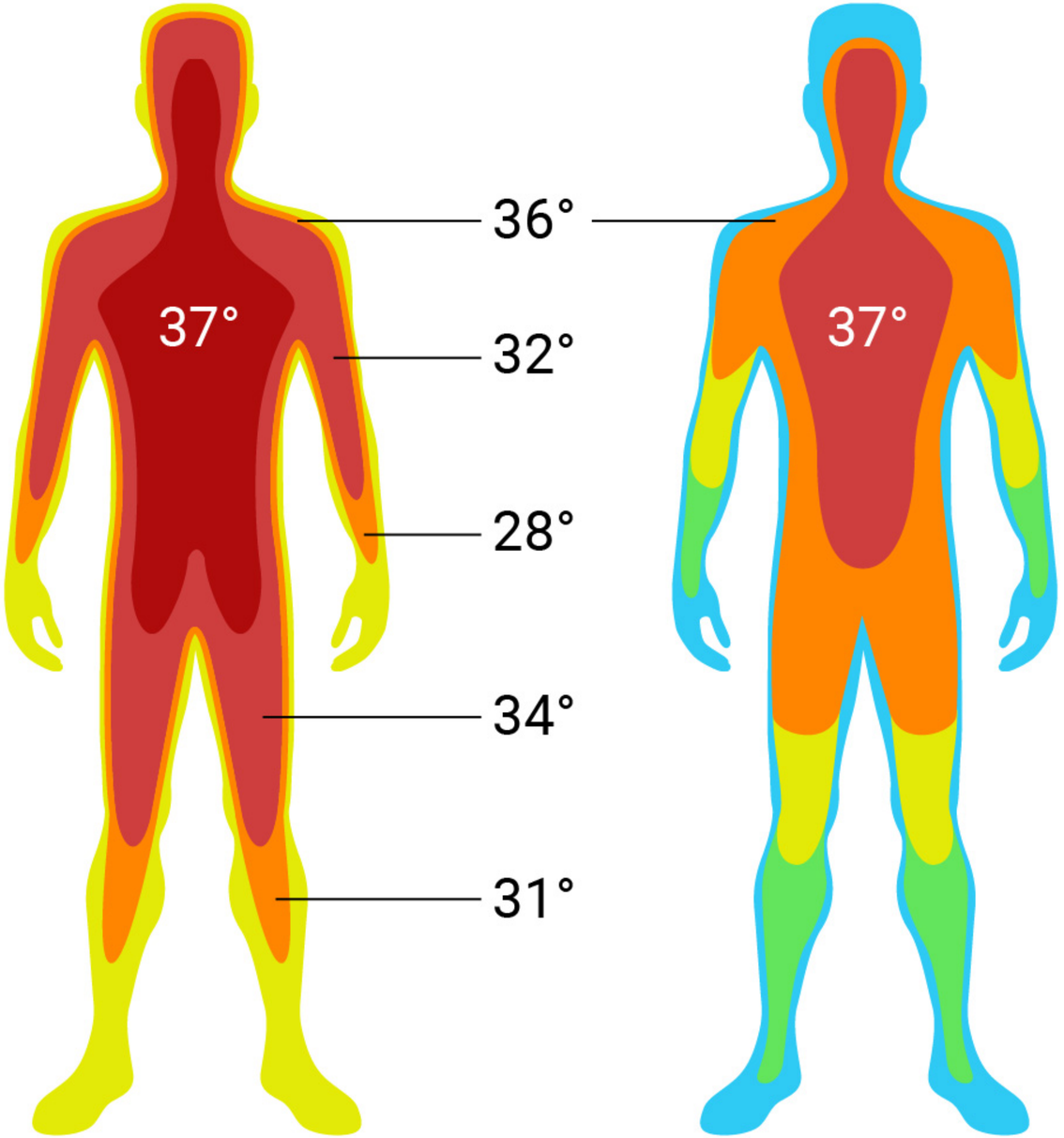
Real Tc at brain and heart



Closely Tc are from intravascular esophagus

Indirect Tc at sublingual and rectum

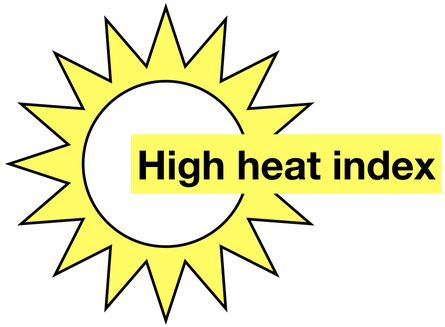
Cannot use axillary, forehead or tympanic membrane temperature

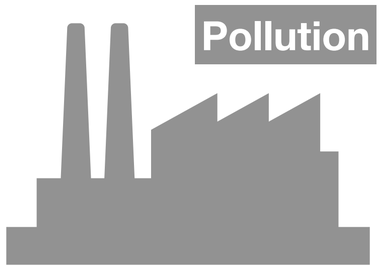


30°C — Ambient temperature — 20°C

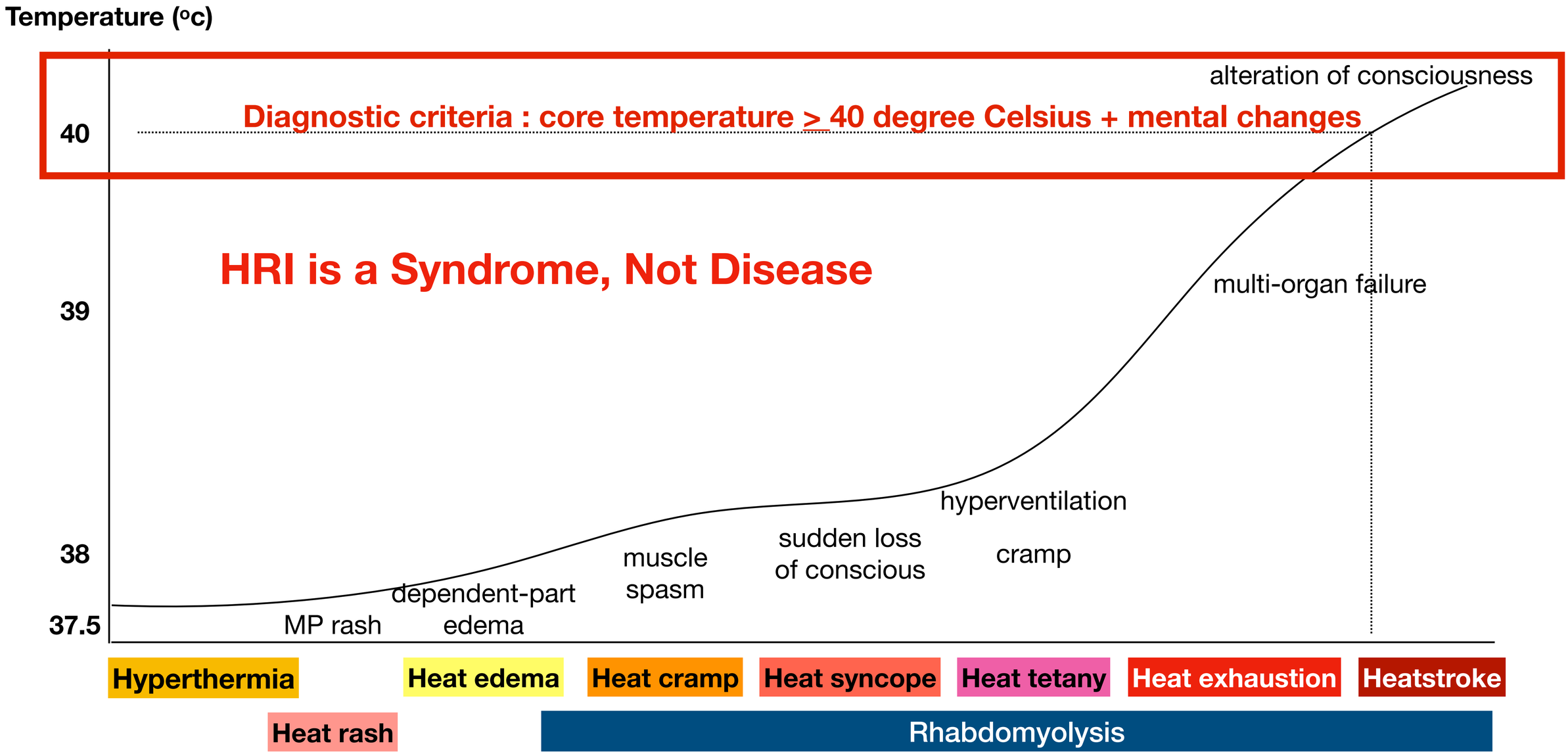
https://www.cosinuss.com/en/measured-data/vital-signs/body-temperature/

Heat accumulation

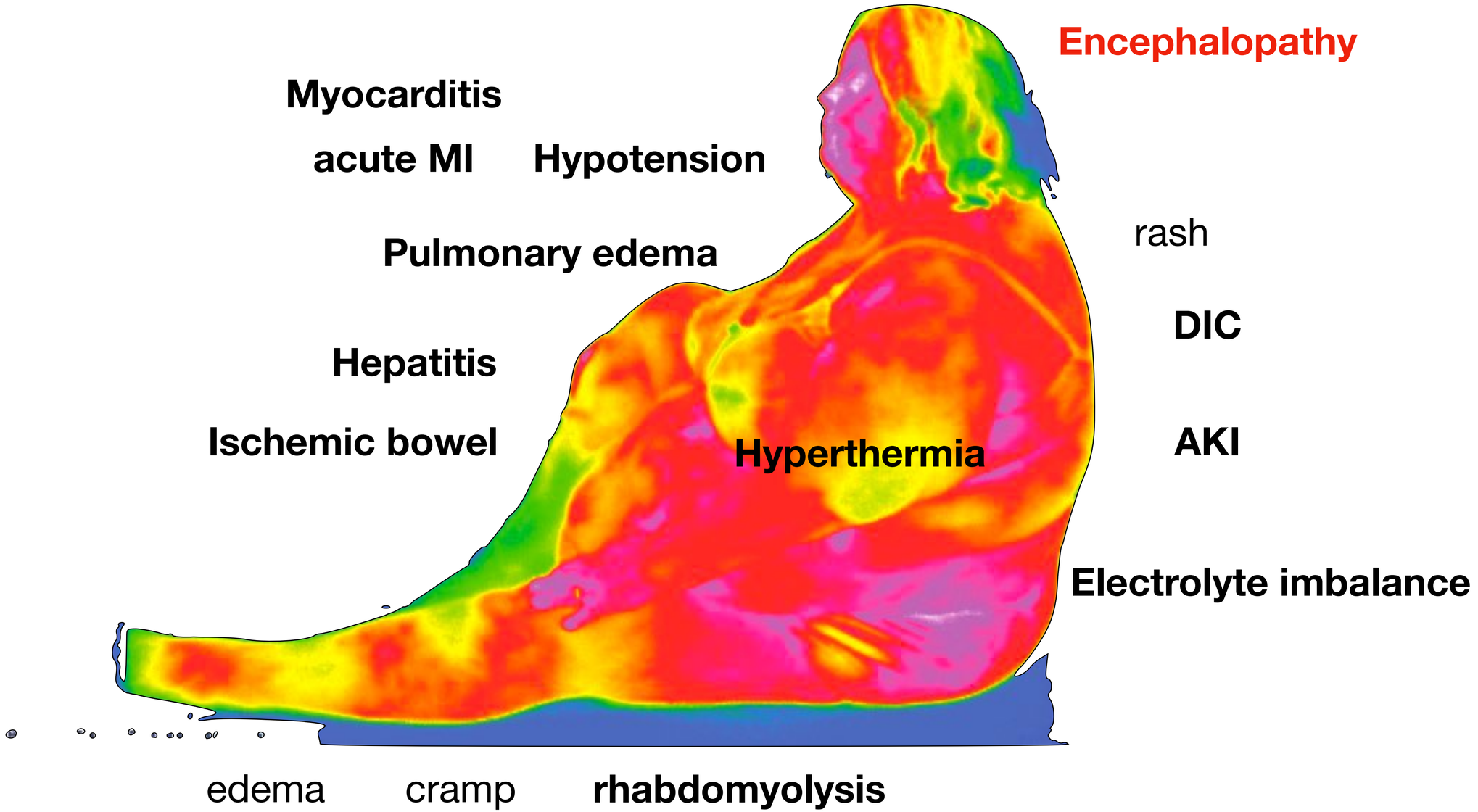




Heat-related illness



Heatstroke = Multiorgan failure



ขอขอบคุณ
พ.อ.หญิง นรีรัตน์ ศรีเลณวัติ

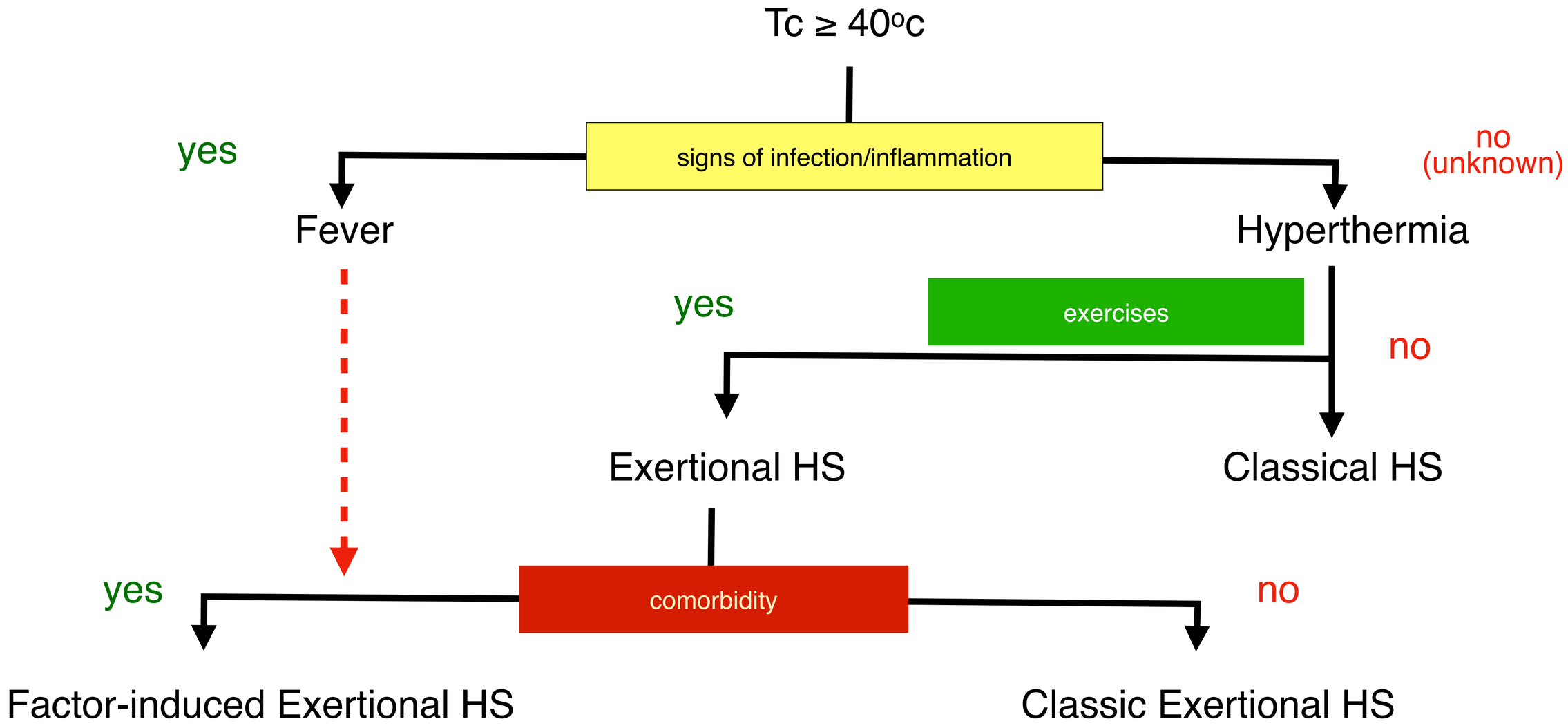
Common pitfalls for diagnosis

1. Delay diagnosis
2. Delay emergency management
3. Misleading diagnosis & treatment

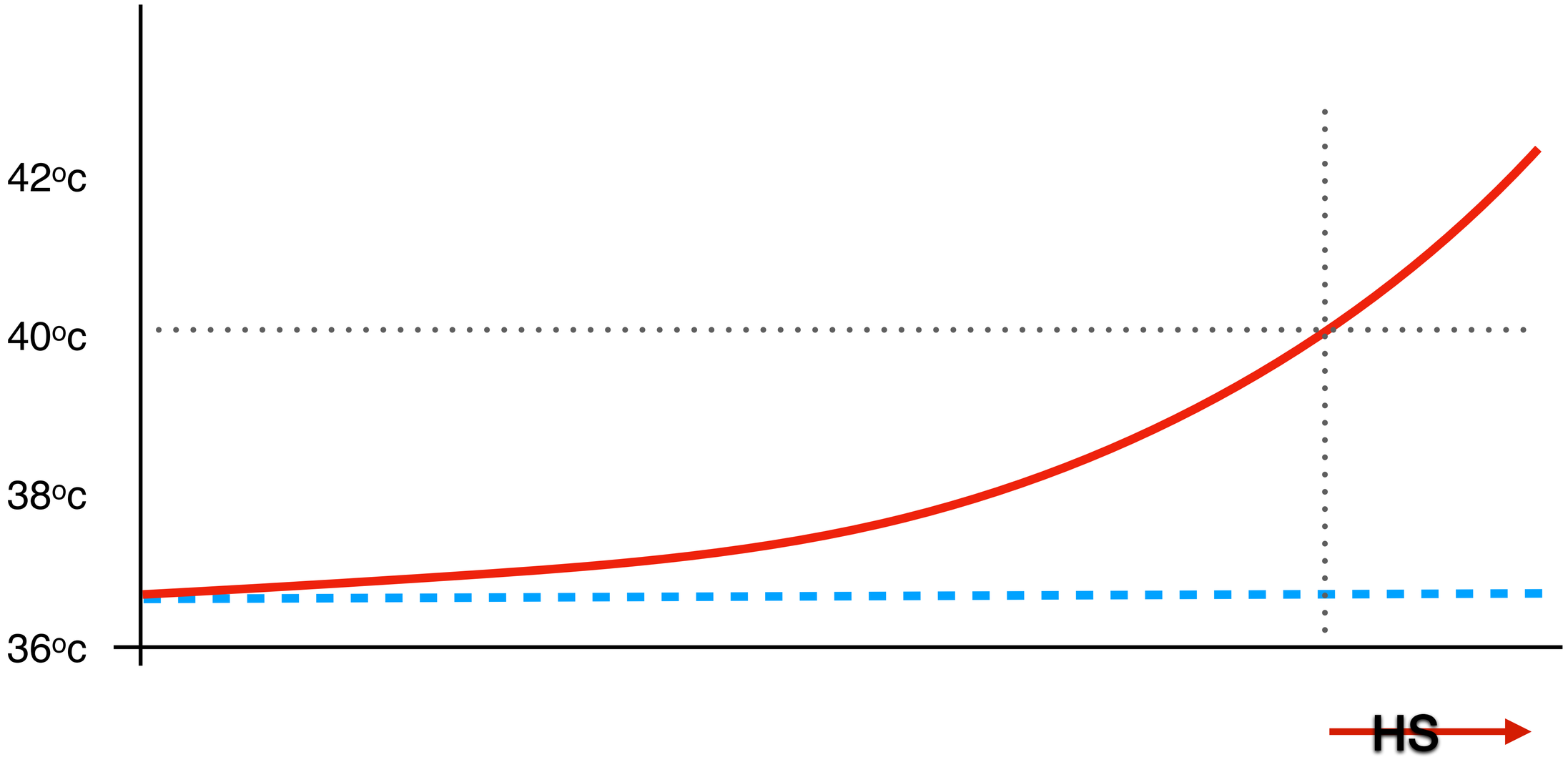
DDx
polypharmacy
toxic ingestions
meningitis
sepsis
neuroleptic malignant syndrome
serotonin syndrome
malaria

Clarify term of fever/ hyperthermia

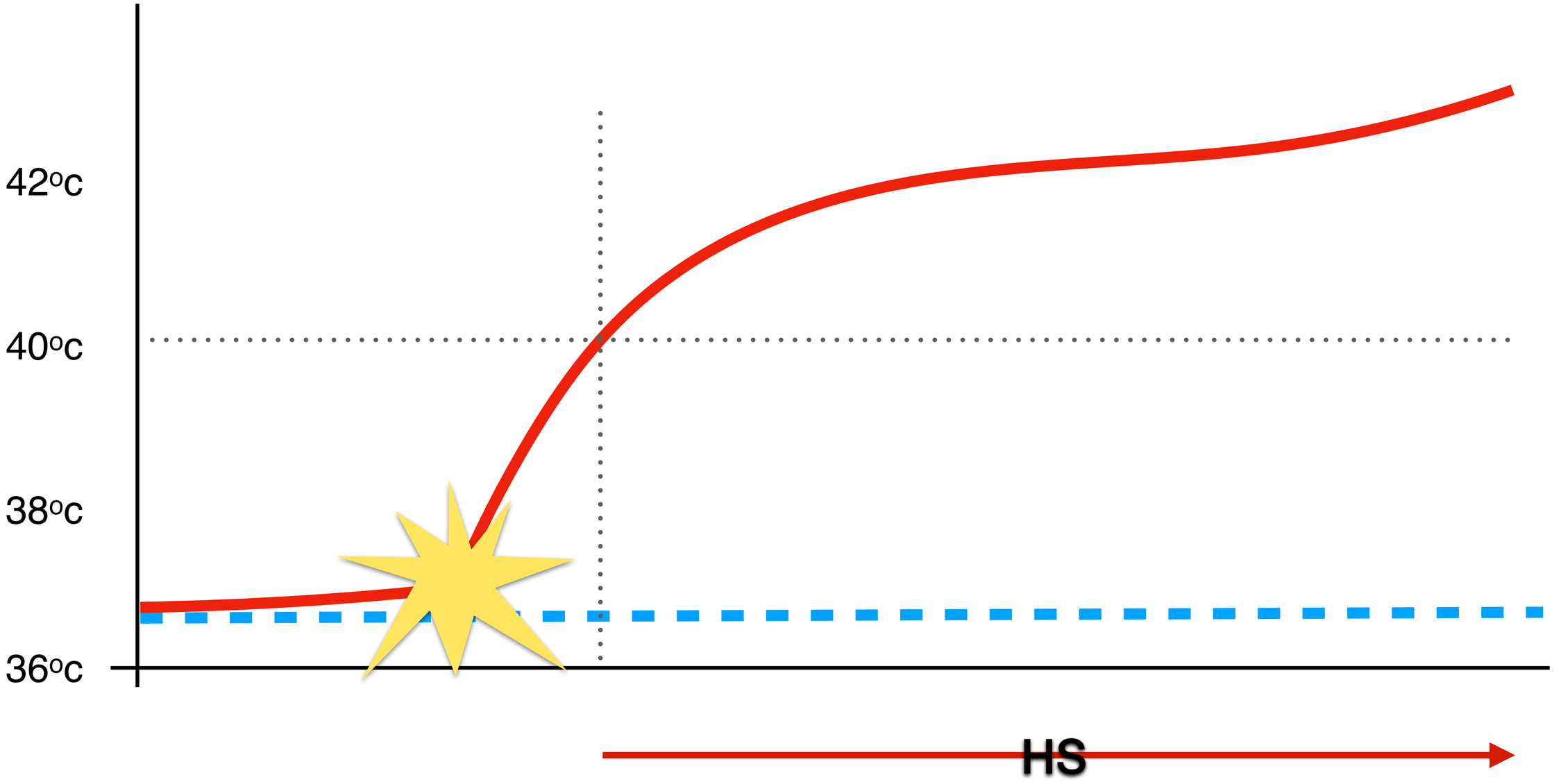
DDx heatstroke from fever



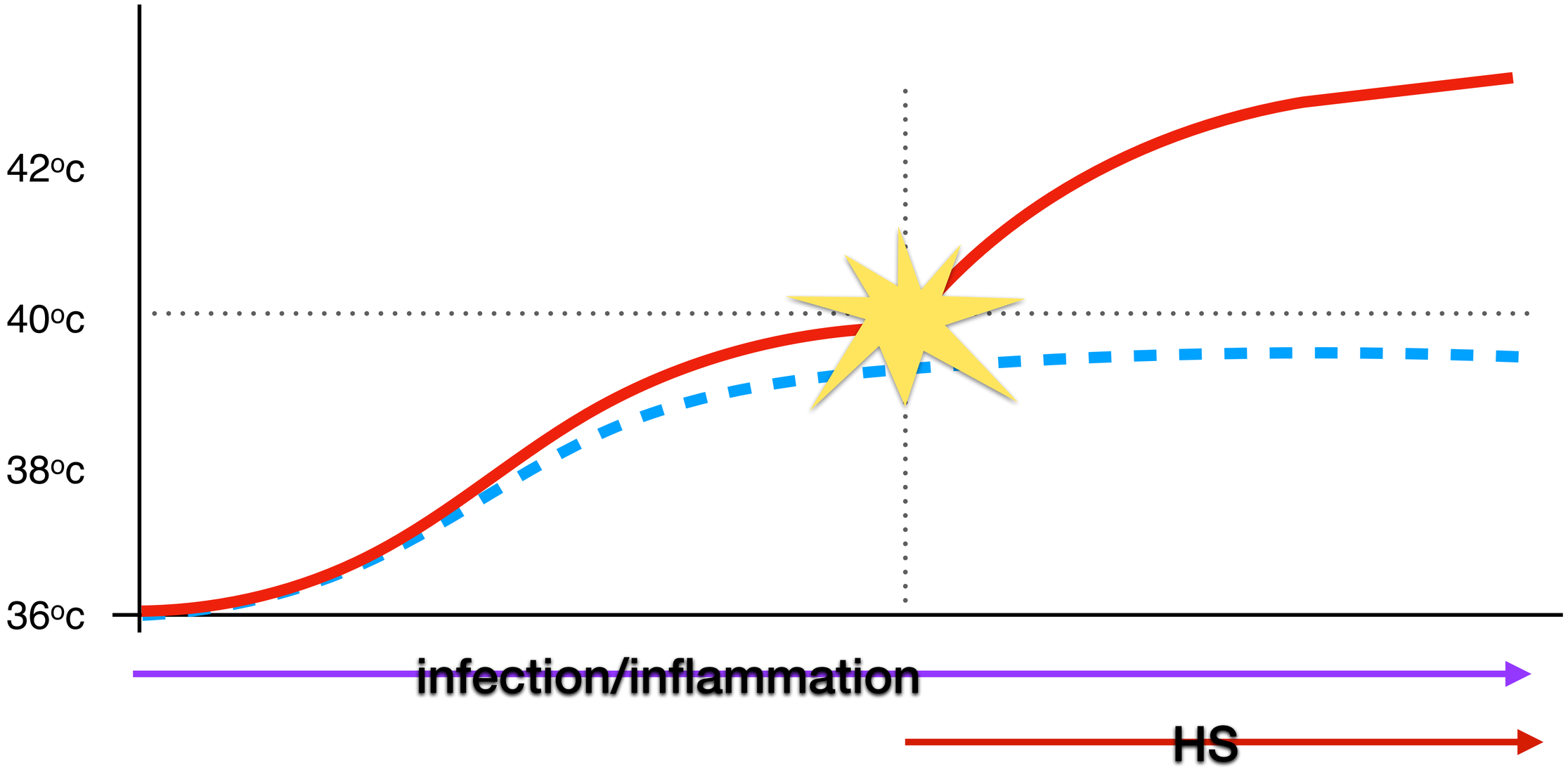
Classical heatstroke



Classic Exertional Heatstroke



Factor-Induced Exertion Heatstroke



Management

- Severity of HRI
- Starting time (onset of symptoms)
- Scene (environment)

Prehospital care

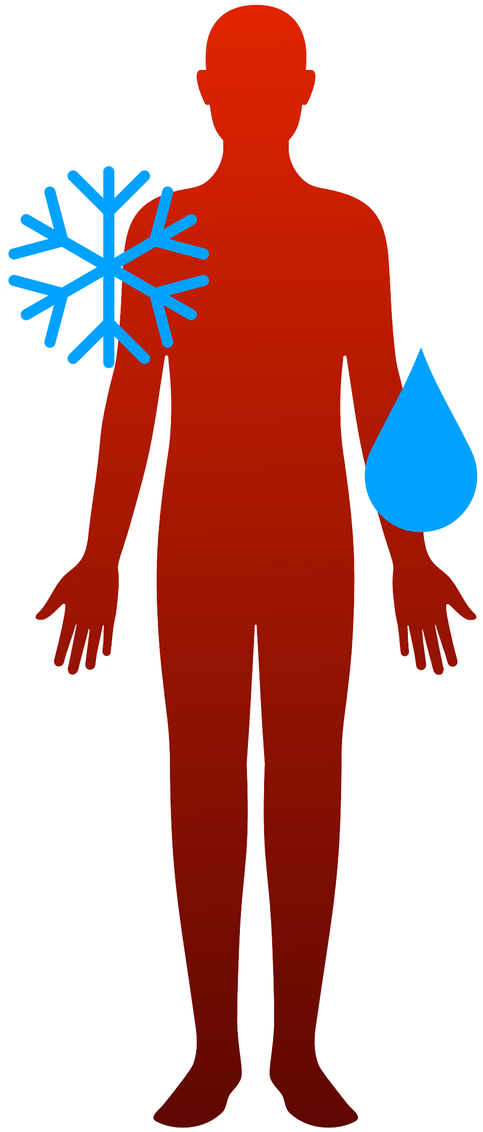
- **E**arly detection : hyperthermia with alteration of consciousness
- **A**voidance : remove from injury place to cooling place
- **S**tart cooling : conduction, convection, evaporation, radiation
- **T**ransportation with care : keep cooling during transportation

Lowering the temperature is the key to treatment

Cooling methods

External cooling

1. Conduction: ice pack, ice sheet, ice submersion
2. Convection: fan
3. Evaporation: foggy, tepid sponge
4. Radiation: cooling place



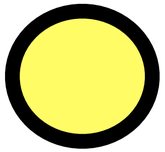
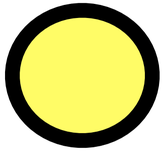
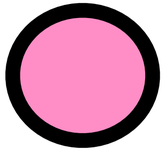
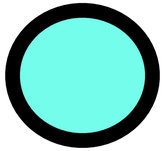
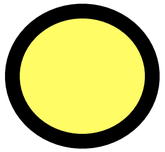
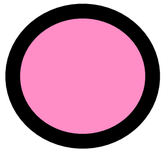
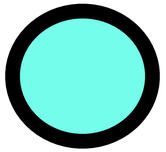
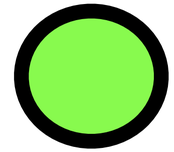
Internal cooling

1. Conduction: IV cold crystalloid
2. Total fluid not over 4 Liters per day

Hospital management

- Temperature control
- Infectious management
- Hemodynamic support
- Organ support

Level of heatstroke care

level	Temperature control	Infectious control	Hemodynamic support	Organ support
at scene				
at ER				
at ICU				

Target temperature

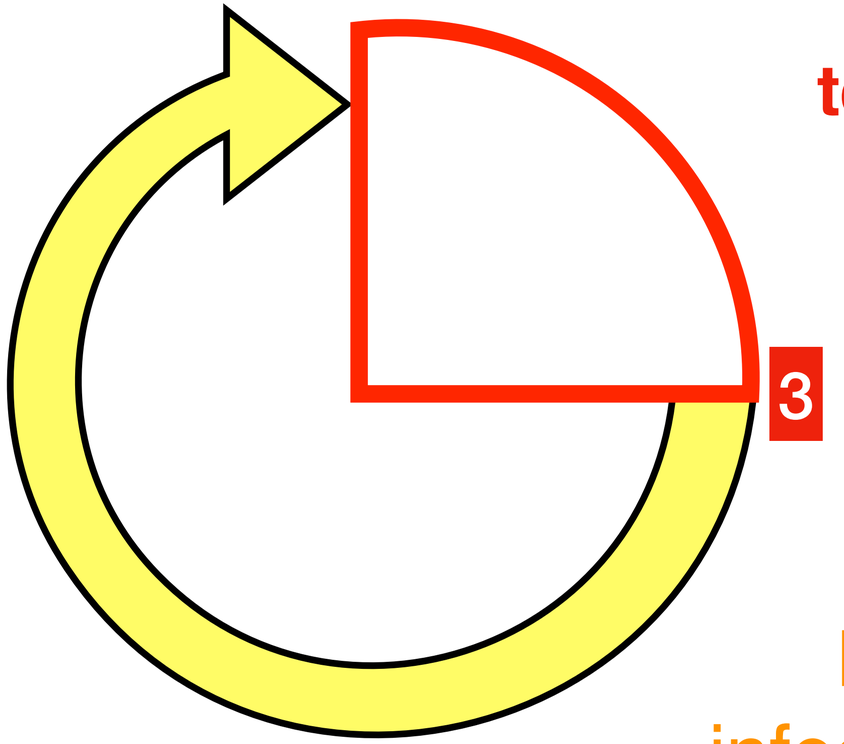
reach the target temperature within 3 h

Temperature	Place	Modalities
38°c	Scene	Cooling place, tepid sponge, ice-sheet, cold pack, fan
≤ 38°c	EMS/ER	+ Cold NSS infusion, Tepid sponge, fan, cold pack
< 36°c or < 33°c	ICU	Cooling pad, cold IV

Temperature control

Common pitfall in heatstroke management

Prevent reheat after temp controlled



Decrease temperature within 3 h

Beware infection in late 24h fever

Sustain target temp at least 24 h

Restoration

Infectious control

1. Treat precipitated infection
2. Prophylaxis antibiotics
3. Treat nosocomial or opportunistic infection

Hemodynamic

1. Cold NSS loading (30 mL/kg) total ≤ 4L in first 24h
2. Keep MAP ≥ 65 mmHg
3. Keep UO ≥ 0.5 mL/kg/h

Organ

1. control seizure (sedation, AEDs)
2. Keep MAP ≥ 65 mmHg
3. monitor electrolyte, CPK, urine
4. etc.

Current RTA heatstroke treatment guideline

Current RTA heatstroke guideline

- Hospital in area : small, medium, large size or medical schools
- Facility of health care provider
- Temperature, critical and organs management

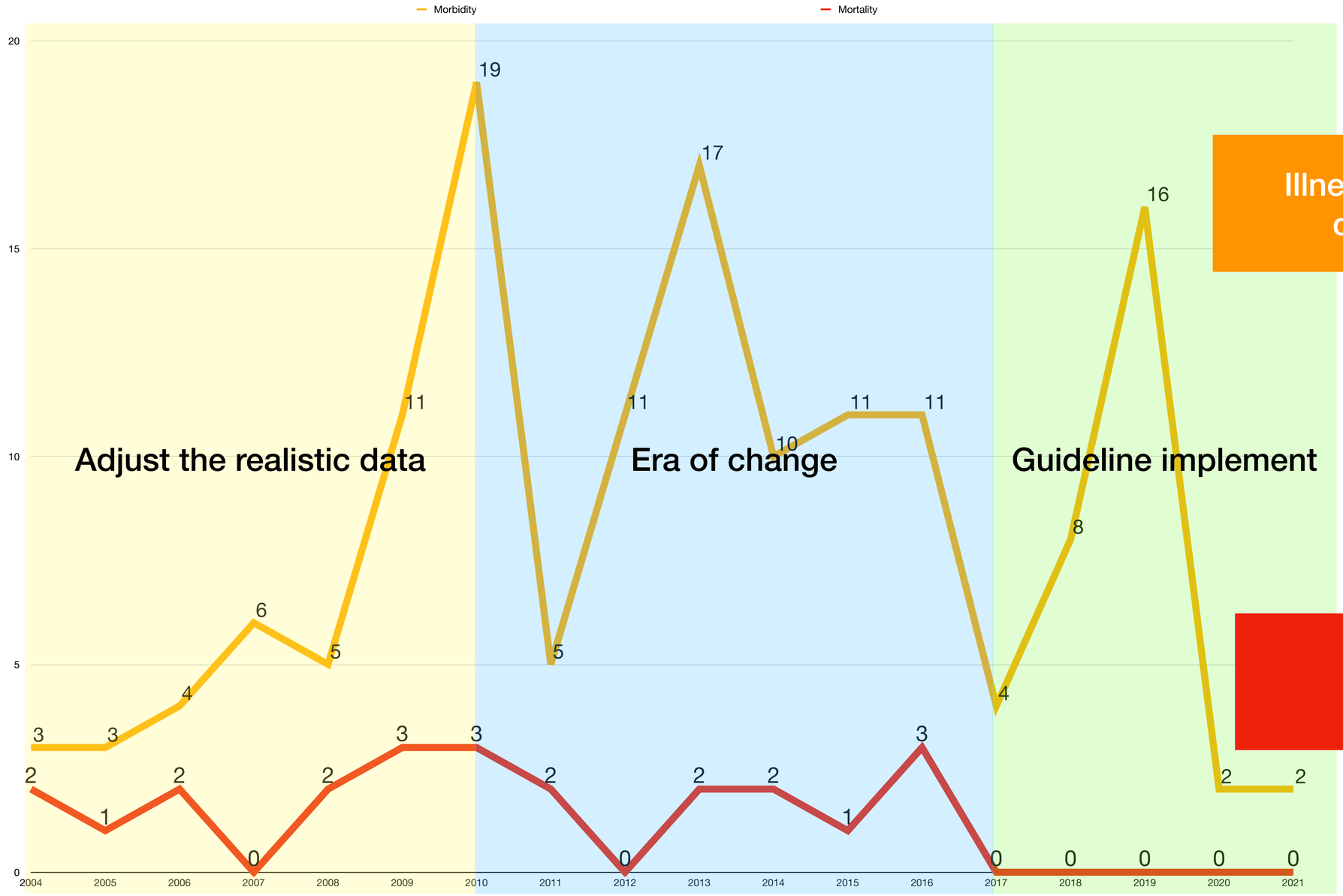
RTA heatstroke guideline

Hospital level		Management		
RTA	MoPH	Temperature control	Critically resuscitation	Organ support
At scene		✓		
Small hospital		✓		
Medium sized hospital		✓	✓	✓
Large hospital		✓	✓	✓
Special sized hospital / medical school hospital		✓	✓	✓

Level			Management									
RTA	MoPH		Temperature control			Resuscitation			Organ support			
			Target temp.	Time to target	Transfer time	Hemodynamic	Monitor	Respiratory	Labolatory	KUB	Neurology	Others
scene			T < 38°c	ASAP	within 30 min	none	T, BP, HR, RR		none	none	none	none
30 beds			T < 38°c	ASAP	within 1 h*	IV fluid**	T, BP, HR, RR	O_2 cannula	Labolatory #	correct life-threatening electrolyte	sedative IV push※	
60 beds	รพช.		T < 38°c	ASAP	within 2 h*	IV fluid**, c-line	T, BP, HR, RR, SpO_2	ET tube	Labolatory ##	correct electrolyte, Ca, P, Mg	sedative IV push※, sedative IV drip※※	stat ATB prophylaxis, PPI prophylaxis
150 beds	รพ.ท.	ER	T < 38°c	ASAP	within 1 h*	IV fluid**, c-line	T, BP, HR, RR, SpO_2	ET tube	Labolatory ##	correct electrolyte, Ca, P, Mg	sedative IV push※, sedative IV drip※※	stat ATB prophylaxis, PPI prophylaxis
		ICU	< 36°c, 33°c if GCS 3	within 3 h		fluid assessment***	T, BP, HR, RR, SpO_2, CVP	ET tube	Labolatory ###	correct all lab, Hemodialysis	sedative + analgesia※※※	surviving sepsis campaign
> 400 beds	รพ.ศูนย์, รร.แพทย์	ER	T < 38°c	ASAP	within 1 h*	IV fluid**, c-line	T, BP, HR, RR, SpO_2	ET tube	Labolatory ##	correct electrolyte, Ca, P, Mg	sedative IV push※, sedative IV drip※※	stat ATB prophylaxis, PPI prophylaxis
		ICU	< 36°c, 33°c if GCS 3	within 3 h		fluid assessment***	T, BP, HR, RR, SpO_2, CVP, A-line	ET tube	Labolatory ###	correct all lab, Hemodialysis, CRRT	sedative + analgesia※※※	surviving sepsis campaign

* if hemodynamic stable , reach to target temperature
** cold NSS infusion 30 cc/kg IBW
*** fluid assessment : CVP, urine output, IVC, fluid responsiveness # electrolyte, BUN/Cr, BS, UA, ECG
electrolyte, BUN/Cr, BS, ECG, CBC, LFT, Uric, UA, ABG, Ca, P, Mg, septic work up
electrolyte, BUN/Cr, BS, ECG, CBC, LFT, Uric, UA, ABG, Ca, P, Mg, septic work up, CPK, Lactate, DIC profile
☼ Diazepam 5 mg IV push or Midazolam 5mg IV push : if seizure or agitation
☼☼ Midazolam IV drip 2.5 - 5 mg/h : for status epilepticus or agitation
☼☼☼ Midazolam IV drip 2.5-5 mg/h + Fentanyl IV 25-50 μg/h : continuous drip 24h then daily interruption

Morbidity & Mortality of EHS in RTA since 2004



Illness does not decrease

Dead = 0

Summary

- Heatstroke affects the entire body, especially the functioning of the brain
- Time is of the utmost importance to heatstroke outcome
- Reducing the temperature will be useful in any high grade fever