



Photo by Alexandre Loureiro



HOW TO **STAY COOL** IN THE HEAT OF THE TOKYO PARALYMPIC GAMES?

AN ATHLETE GUIDE

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WHY SHOULD I CONSIDER COOLING BEFORE (PRE) OR DURING (PER) EXERCISE?

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1. Cooling has been shown to **improve sports performance** in the heat
2. Cooling can **improve how comfortable you feel** eat for **improved decision making**
3. Cooling is **beneficial to athletes with a disability** but different methods may be required
4. Cooling can **reduce the risk of heat illness**



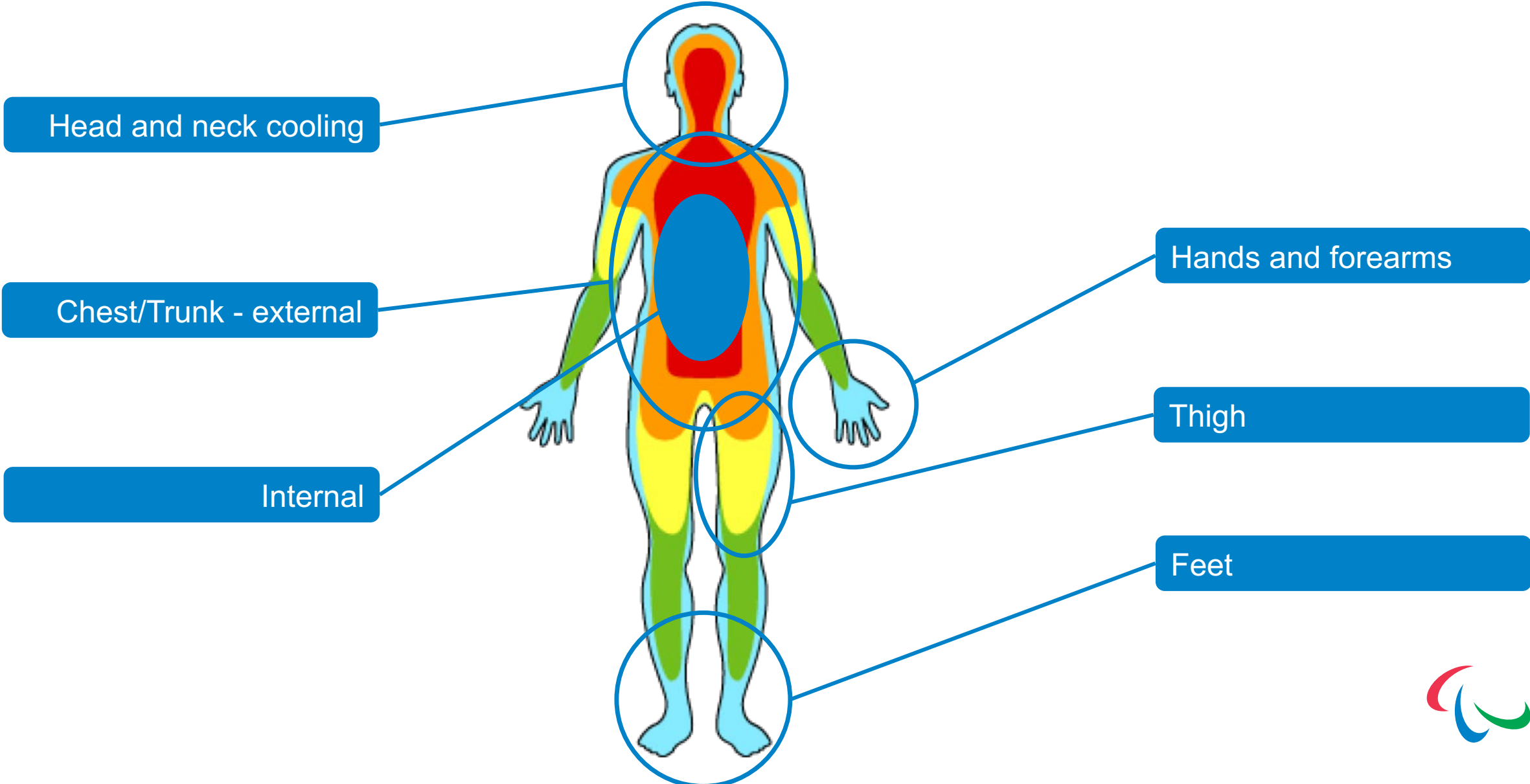
WHAT ARE THE COOLING ESSENTIALS I NEED TO CONSIDER?

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- 🎯 Decide by trial **which cooling method/s** work best for you
- 🎯 Decide on **what sites on the body you can easily target**
- 🎯 Decide on whether you plan to use **internal (fluids/slushies)** or **external cooling** or ideally a **combination of both**
- 🎯 **Think practical** – what works in your sport environment, and with your equipment



WHERE CAN I COOL? POSSIBLE TARGET SITES 4



WHAT PRACTICAL METHODS CAN I USE TO COOL?



Considerations

1. Your level of **disability/impairment**
2. Constraints of your **sport** – rules, timing, breaks
3. Will it work with my **equipment** – e.g. push gloves, prosthetic
4. How **effective** is the cooling method for you
5. What is **available** at your competition venue e.g. ice, freezer



Lots of methods - what will work for you?

Test and Practice - Test and Practice - Test and Practice



HOW TO COOL (EXTERNAL): HEAD/NECK PRE-COOLING

Method	Dose	Duration	Time	Considerations
Ice-Hood Neck Collar Cold, Wet Towels Water douse	Frozen Ice pack (0°C)	10-20 min	Before, During &/or After Warm up & Event	<ul style="list-style-type: none"> • Cold-induced Freezing Injury e.g. ice burn • Dry clothes and towel required • Potential to mask heat illness symptoms.
Alternate Methods	External: Forearm & Hand Cooling, Fan-Mist Spray Internal: Ice-Slurry			



HOW TO COOL (EXTERNAL): FACE PRE-COOLING

Method	Dose	Duration	Time	Considerations
Fan &/or Mist Spray	10-20°C Water 500mL	Free-Use	Before, During &/or After Warm up & Event	<ul style="list-style-type: none">• Dry clothes and towel required• Clean, drinkable water
Alternate Methods	External: Forearm & Hand Cooling, Fan-Mist Spray Internal: Ice-Slurry			



HOW TO COOL: WHOLE- & PARTIAL-BODY PRE-COOLING

Method	Dose	Duration	Time	Considerations
Whole- Body	15-25°C	10-20 min	Before or After Warm up & Event	<ul style="list-style-type: none"> • Possibly no visible reduction in T_{CORE} until after the cooling has finished (i.e. an 'afterdrop'). • The guide should be the duration of cooling rather than for a specific decline in T_{CORE} due to the likelihood of an afterdrop. • Watch for 'overshoot' in SCI athlete • Change of clothes/dry towel required
Partial-Body (Lower-Leg) (Whole-Leg)	15-25°C	15-30 min		
Alternate Methods	External: Ice-Vest & Cold, Wet Towels Internal: Ice-Slurry			

**Caution in SCI
Over-cooling**



HOW TO COOL (EXTERNAL): HEAD/NECK PRE-COOLING

Method	Dose	Duration	Time	Considerations
Hand-Cooler Ice-Packs Ice-Pops RTX Body Cooler	Frozen Ice pack (0°C)	10-20 min	Before, During &/or After Warm up & Event	<ul style="list-style-type: none"> No direct skin contact to avoid cold-induced Freezing Injury e.g. ice burn Reduction in manual dexterity
Alternate Methods	External: Forearm & Hand Cooling, Fan-Mist Spray Internal: Ice-Slurry			



HOW TO COOL (EXTERNAL): TORSO

PRE-COOLING

Method	Dose	Duration	Time	Considerations
Ice-Vest Cold, Wet Towels Ice packs	Frozen Ice pack (0°C)	10-20 min	Before, During &/or After Warm up & Event	<ul style="list-style-type: none"> Cold-induced Freezing Injury e.g. ice burn Vests need to be tight fitting so that they maximise surface contact area and cooling impulse
Alternate Methods	External: Forearm & Hand Cooling, Fan-Mist Spray Internal: Ice-Slurry			



HOW TO COOL (EXTERNAL): FOREARM/FEET PRE-COOLING

Method	Dose	Duration	Time	Considerations
Forearm-Cooler Forearm/ Foot Immersion Liquid-gel insoles	Frozen pack (0°C) 15-25°C	10-20 min	Before, During &/or After Warm up & Event	<ul style="list-style-type: none"> • Cold-induced Freezing Injury e.g. ice burn • Dry clothes and towel required
Alternate Methods	External: Forearm & Hand Cooling, Fan-Mist Spray Internal: Ice-Slurry			



HOW TO COOL (EXTERNAL): FOREARM/FEET PRE-COOLING

Method	Dose	Duration	Time	Considerations
Ice-slurry	~7g/kg of body mass 0°C	10-20 min	Before, During &/or After Warm up & Event	<ul style="list-style-type: none"> • T_{CORE} reduced by 0.2-0.6°C • Individual responses • Mild Gastrointestinal issues • Elevated urination issues • Ice ingestion alone increases likelihood of sphenopalatine ganglioneuralgia ('brain freeze') & choking risk • Mixing liquid and crushed ice (i.e. slurry/slushy) is more suitable.
Cold Drinks	500mL 5-15°C	(<i>ad libitum</i>)		
Alternate Methods	External: Ice-Vest & Cold, Wet Towels Internal: Ice-Pop			



WHICH COOLING METHODS ARE BEST?

Cooling Strategies

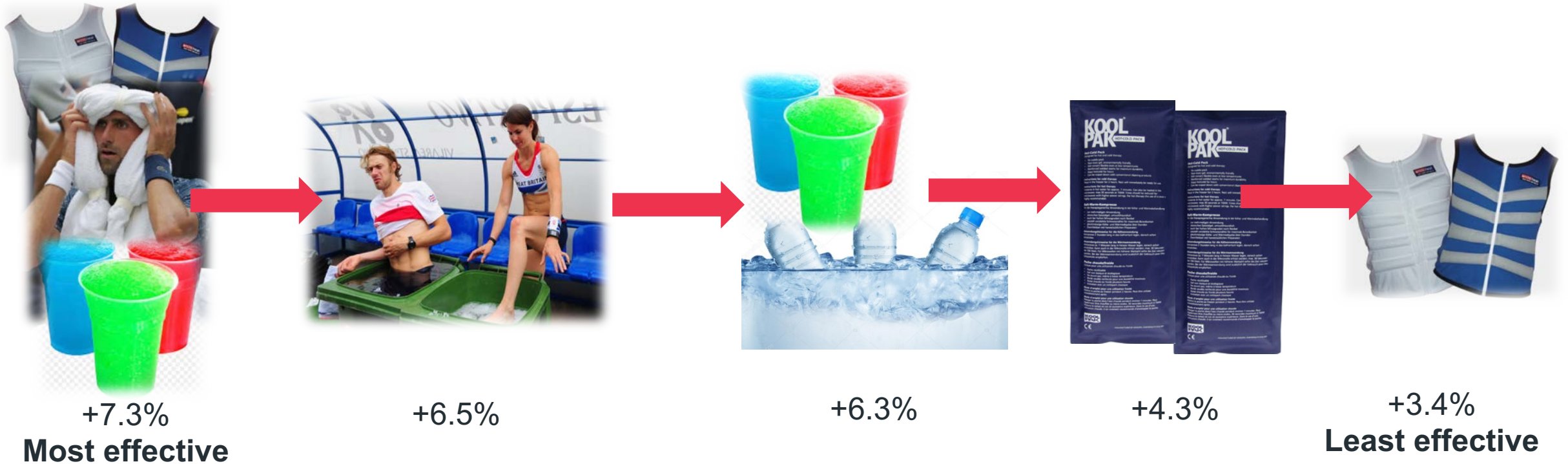
Strategy	Pre-Cooling Feasibility	Pre-Cooling Effectivity	Per-Cooling Feasibility	Per-Cooling Effectivity
Cooling Vest	✓	+	✓	+
Ice Vest	✓	+	✓	++
Cold water ingestion	✓	++	✓	+
Ice slurry ingestion	✓	+++	✓	+
Menthol cooling	✓	+	✓	++
Facial wind/water spray	✓	++	✓	+++
Cooling packs	✓	+	✓	+
Cold water immersion	✓	+++	✗	

The most feasible may not be the most effective and vice versa, so plan your cooling strategy ahead of your competition.

(Bongers et al., 2013; 2017)



POTENCY OF PRE-COOLING



Mixture of methods appear to be the most effective strategy to enhance performance

(Bongers et al., 2013; 2017)



DOES PRE & PER-COOLING HELP PARALYMPIC ATHLETES?

8 males with SCI
28 min intermittent sprint arm cranking protocol
Three heat stress trials in 32°C 50% RH
(a) No cooling control
(b) 20 min precooling with ice vest
(c) Cooling during exercise (ice vest worn in exercise)



Pre & per-cooling can:

- reduce core body temperature
- reduce heart rate
- reduce how hard exercise feels
- reduce how hot athletes feel
- improve exercise performance

J Appl Physiol 98: 2101–2107, 2005.
First published January 27, 2005; doi:10.1152/jappphysiol.00784.2004.

Effects of two cooling strategies on thermoregulatory responses of tetraplegic athletes during repeated intermittent exercise in the heat

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WHEN TO COOL

Before	During (if possible)	During breaks (sport specific)
Internal	Internal	Internal
External	External	External
20 min	Maximum duration possible	Maximum duration possible
Until end of w/up		

Internal – Ice Slurry / Cold Drinks
External – Chosen method - tested and available

Don't forget recovery afterwards!



AN EXAMPLE STRATEGY FOR A TEAM-BASED SPORT

PRE game



20 min with cooling /ice vest

500 ml ice slurry consumed at 10, 20 and 30 min (160 ml x 3)

During



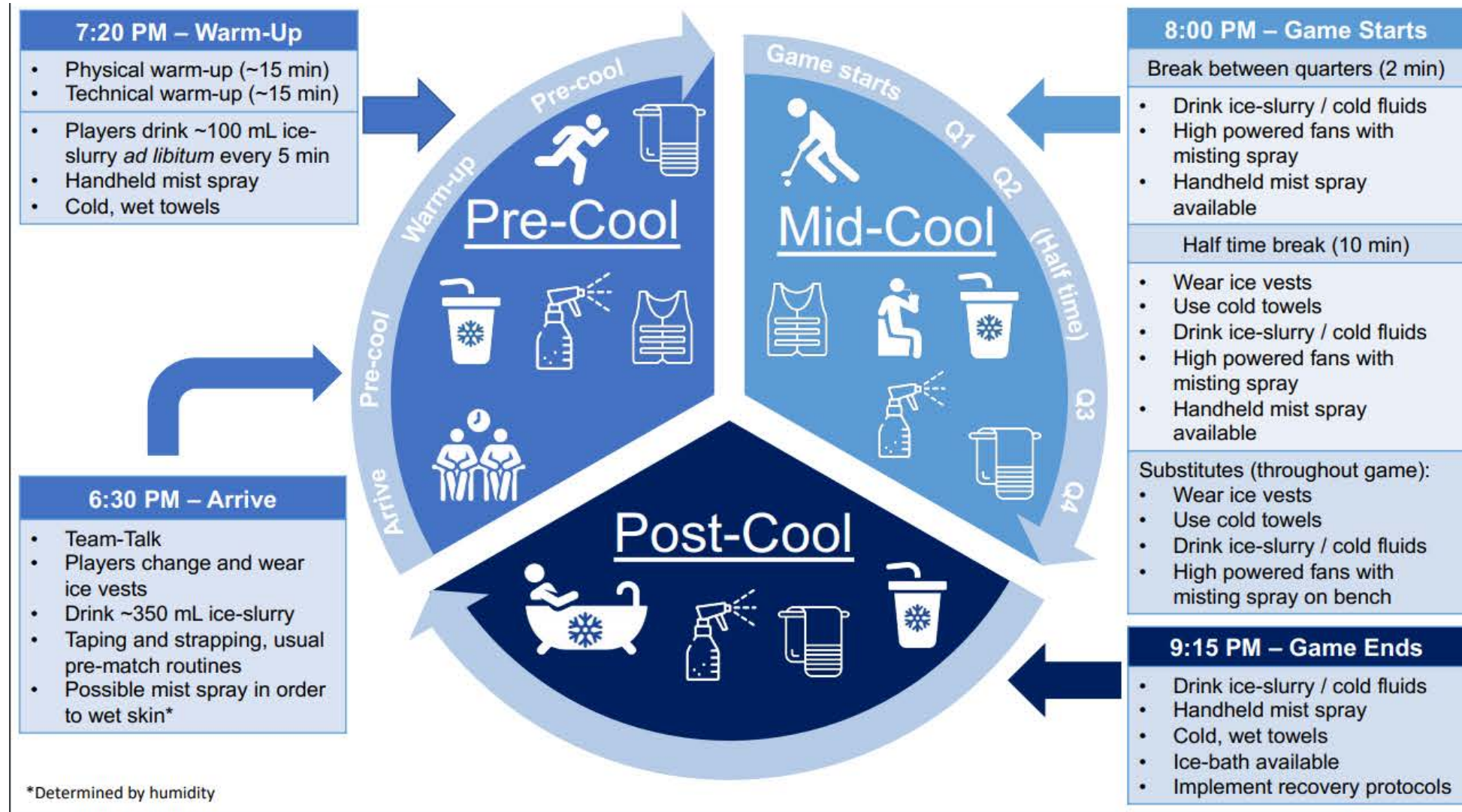
During breaks



Immediate Cooling:
ice towel / ice vest / hand cooling

250 ml ice slurry consumed at 0 and 5 min (2 x 125 ml)

AN APPLIED EXAMPLE OF HOW TO COOL



SPECIFIC COOLING CONSIDERATIONS FOR PARALYMPIC ATHLETES

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1. **External cooling methods** (e.g. ice vests) - rely on direct contact with a large skin surface area – might be difficult with equipment or use in a sports wheelchair. Consider different options e.g. misting and fanning, ice towels etc.

2. **Ice slurries** can reduce sweat rate and slow heat loss but can be effective in humid conditions like Tokyo

3. **Too much fluid too quickly** can cause gut discomfort or a need for frequent visits to the toilet. Keep a steady pace of drinking that you have practiced.

4. **Hand Cooling**, while effective at reducing heat, can reduce function and grip, or be difficult for glove wearers. Focus on cooling non-active body parts.

RESOURCES THAT SUPPORTED THIS PRESENTATION

- Bongers, C.C.W.G, Hopman, M.T.E., Eijsvogels, T.M.H. (2017) [Cooling interventions for athletes: An overview of effectiveness, physiological mechanisms, and practical considerations](#), *Temperature*, 4:1, 60-78.
- Bongers, C.C.W.G, Thijssen. D.H.J., Veltmeijer, M.T.W. (2014) [Precooling and percooling \(cooling during exercise\) both improve performance in the heat: A meta-analytical review](#), *British Journal of Sport Medicine*, 49(6), 377-384.
- Forsyth, P., Pumpa, K., Knight, E. and Miller, J. (2016) [Physiological and perceptual effects of precooling in wheelchair basketball athletes](#) *The Journal of Spinal Cord Medicine*, 39 (6), 671 – 678.
- Gibson, O. R., James, C., Mee, J. A., Willmott, A., Turner, G., Hayes, M. & Maxwell, N., (2020). [Heat alleviation strategies for athletic performance: a review and practitioner guidelines](#) *Temperature*, 7, Special Issue 1 of 2.
- Goosey-Tolfrey, V., Swainson, M., Boyd, C., Atkinson, G. and Tolfrey. K (2008) [The effectiveness of hand cooling at reducing exercise-induced hyperthermia](#), *J Appl Physiol*, 105, 37-43.
- Griggs, K.E., Stephenson, B.T., Prince, M.J. and Goosey-Tolfrey, V.L. (2020). [Heat-related issues and practical applications for Paralympic athletes at Tokyo 2020](#), *Temperature*, 7, Special Issue 1 of 2.
- Griggs, K.E., Price, M.J., Goosey-Tolfrey, V.L. (2015) [Cooling Athletes with a Spinal Cord Injury](#), *Sports Med*, 45: 9-21
- Naito, T. and Hayashi, S. (2019) [Effective Cooling Strategies to Reduce Body Temperature in Individuals with Spinal Cord Injury](#), *Int J. Sport Health Sci*, 63, 1-11.
- Pritchett, K., Broad, E. Scaramella, J. and Baumann, S. (2020) [Hydration and Cooling Strategies for Paralympic Athletes](#), *Current Nutrition Reports*, Sep;9(3):137-146.
- Webborn, N., Price, M., Castle, P. and Goosey-Tolfrey, V.L. (2005) [Effects of two cooling strategies on thermoregulatory responses of tetraplegic athletes during repeated intermittent exercise in the heat](#), *J Appl Physiol*, 98, 2101-2107.



**IT SHOULD NOT BE A MATTER OF IF I WILL USE COOLING,
BUT MORE WHAT COOLING WILL I USE IN TOKYO!**

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THANK YOU

