Climate Change, Heat Stress and Worker Health

AMERICAN COLLEGE OF OCCUPATIONAL AND ENVIRONMENTAL MEDICINE

Ronda McCarthy, MD, MPH, FACOEM
National Medical Director, Medical Surveillance Services
Concentra

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Learning Objectives

- Understand how climate change, specifically increased ambient temperature, is impacting vulnerable workers.
- Learn the direct and indirect impact of heat exposure on worker health.
- Discover the results of a successful employer-based occupational heat-related illness (HRI) prevention program.

Climate Change and Increased Ambient Temperature

Heat Stress, A Global Phenomenon

In 138 years of NOAA data, 2009 to 2019 was the hottest decade on record.

Higher ambient temperatures

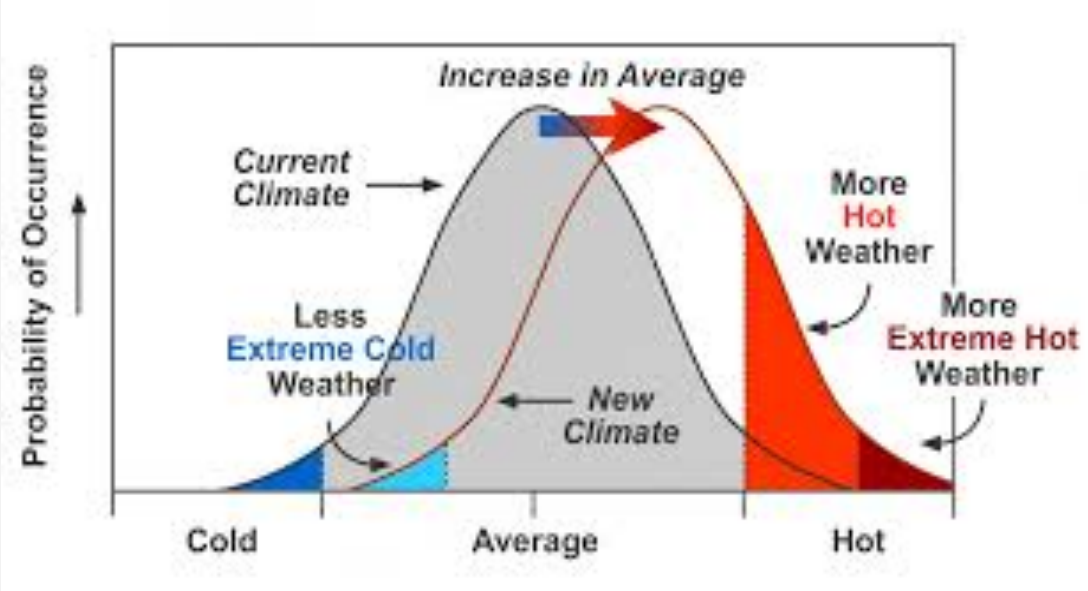
- More air pollution
- Increased UV radiation
- More weather extremes
- Increase in vector-borne diseases

National Oceanic Atmospheric Administration www.noaa.gov

Increased Ambient Temperature

We can expect to see:

- Extended hot seasons
- More days over 90 degrees
- Added heat waves, in both:
  - Duration
  - Frequency



Heat Stress and its Impact on Workers

"Every year, thousands of workers become sick from occupational heat exposure, and some are fatally injured. These illnesses and fatalities are preventable."

- OSHA

Heat Stress and its Impact on Workers

Heat stress/strain:

heat load >> cooling

Contributors to a high net heat load:

- Environment
- Metabolic heat/physical activity
- Clothing, personal protective equipment (PPE)
- Individual factors

Cooling

Evaporation through sweating is a key moderating factor. But...

- Only a liter an hour of water can be absorbed by drinking
- Sweating is not effective when relative humidity exceeds 75%

Heat Stress and its Impact on Workers

Direct Effects of Heat Stress

Heat Syncope	Dehydrated or poorly acclimatized individuals develop peripheral vessel dilation, diminished blood flow to the brain, and faint
Heat Cramps	Excessive sweating resulting in muscle cramps or spasms
Heat Exhaustion	Increased core body temperature, decreased cardiac output
Heat Injury	Rhabdomyolysis, acute renal injury, disseminated intravascular coagulation, acute liver failure, increased core body temperature
Heat Stroke	Multisystem failure, central nervous system dysfunction, high core body temperature

https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106
www.UpToDate.com

Heat stroke is a medical emergency.

- Body can no longer regulate temperature
- Any delay in treatment increases risk of permanent illness and death

https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106

Heat Stress and its Impact on Workers

Other Health Effects of Heat Stress

Exacerbation of co-morbidities	Cardiovascular, renal, pulmonary disease and diabetes
Mental health	Aggression, anxiety, depression, exacerbation of mental illness
Renal disease	Acute renal injury, renal failure, chronic kidney disease

https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106

Heat Stress and its Impact on Workers

Indirect Effects of Heat Stress

The effects of heat stress impact the entire company through:

Increased Accidents

- Dizziness
- Sweaty palms
- Fogged safety glasses
- Slowed reaction time

Reduced Work Performance

- Distracted by discomfort
- Agitation
- Fatigue
- Cognitive impairment

Increased Health Care/ Workers' Compensation Costs

- Heat related illness and fatalities
- Exacerbation of co-morbidities
- Higher incidence of burns
- Accidents

https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106

Heat Stress: Risk Factors

Heat Stress: Risk Factors
Thermal Environment

- Air temperature
- Humidity
- Air movement
- Radiant heat from the sun and other sources

https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106

Heat Stress: Risk Factors
Job Specific

Work Demands

- Duration of heat exposure
- Physical requirements
- New workers and workers returning from extended absence

PPE & Clothing Requirements

- Respirators
- Impermeable PPE
- Uniforms

https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106

Heat Stress: Risk Factors

Individual

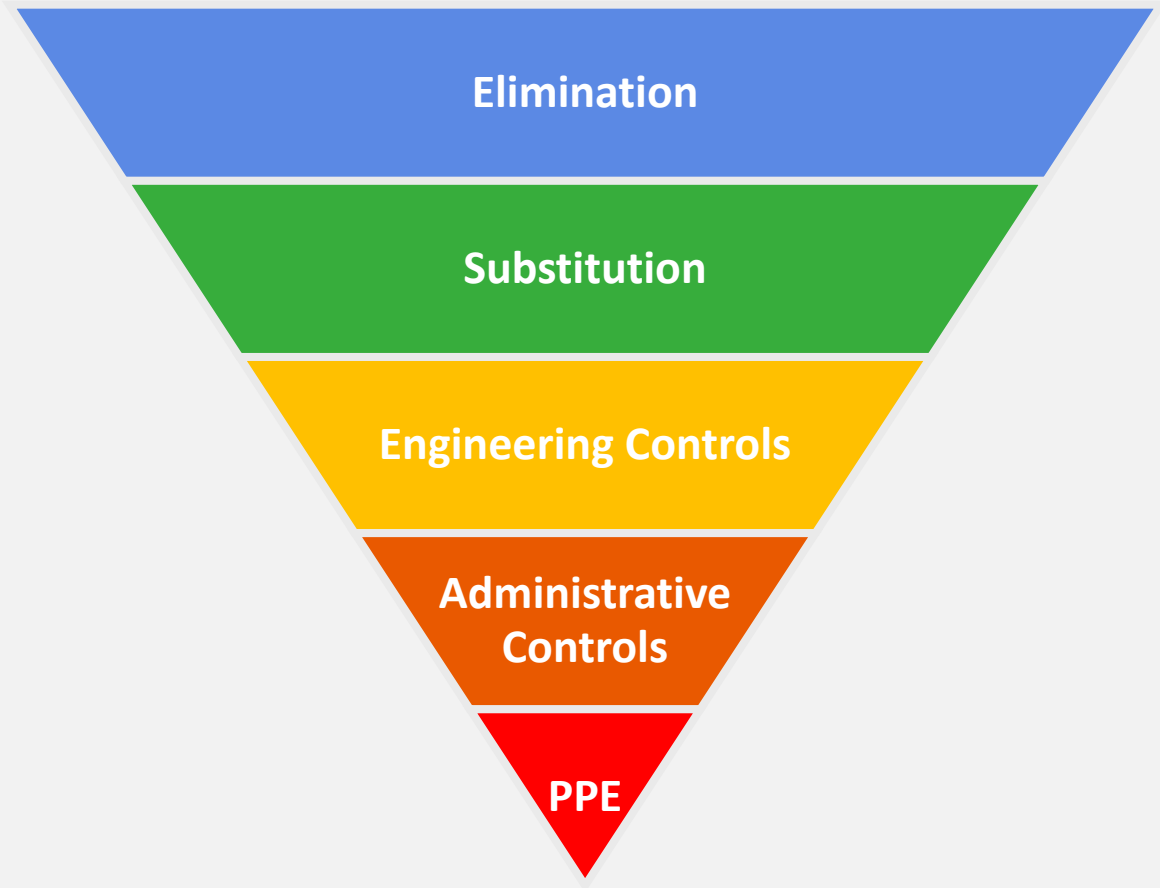
- Age
- Obesity
- Prior HRI
- Pregnant women
- Co-morbidities: heart disease, diabetes, lung disease and kidney disease
- Poor physical fitness
- Alcohol or drugs
- Medications
- Acute illnesses causing dehydration
- Skin conditions

https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106

Heat Stress Prevention Programs

Heat Stress Prevention Program
Hierarchy of Controls

- Engineering controls
  - Cool the environment
- Administrative controls
  - Water, rest periods
  - Acclimatization program
  - Training
  - First aid and emergency response procedures
  - Buddy system
- Medical monitoring and surveillance
- Thermal considerations for PPE and clothing



https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106

Heat Stress Prevention Program
Engineering Controls

Engineering Controls

- Air conditioning/shade
- Ventilation
- Cooling fans
- Reflective shields

https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106

Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 63 / No. 31
August 8, 2014

Heat Illness and Death Among Workers — United States, 2012–2013

Sheila Arbury, MPH[1], Brenda Jacklitsch, MS[2], Opeyemi Farquah[3], Michael Hodgson, MD[4], Glenn Lamson, MS[5], Heather Martin, MSPH[3], Audrey Profitt, MPH[6] (Author affiliations at end of text)

"Employers' failure to support acclimatization appears to be the most common deficiency and the factor most clearly associated with death."

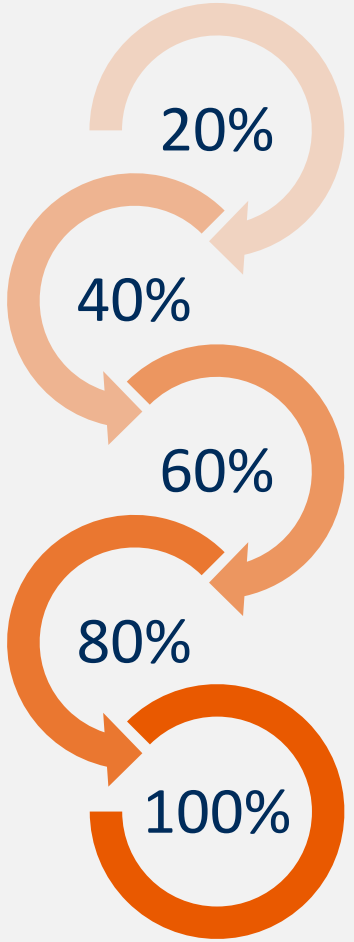
Heat Stress Prevention Program

NIOSH's Recommended Acclimatization Plan

Gradual Exposure to Heat

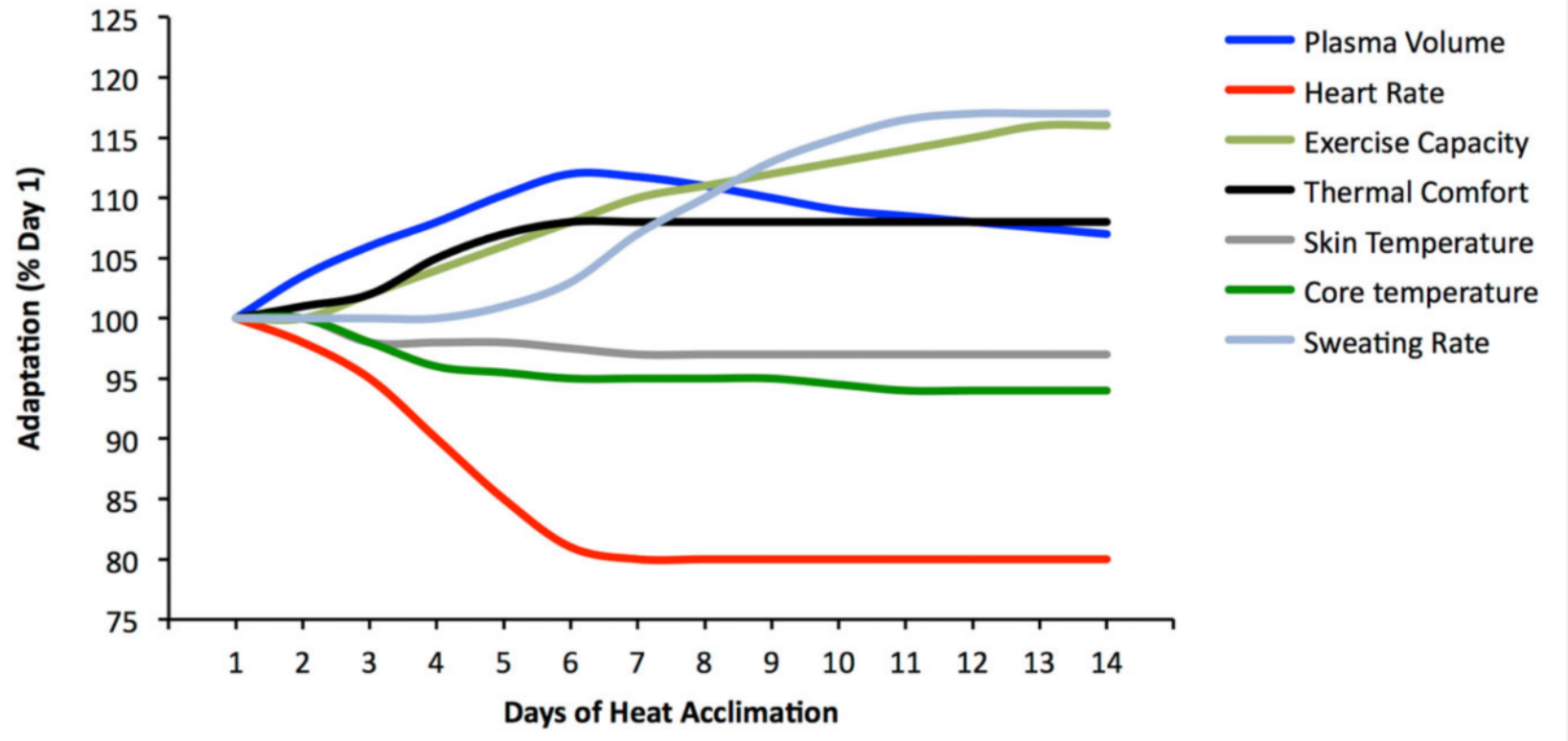
Increase exposure time in hot environmental conditions over a 7-14 day period depending on environmental and individual risk factors

For new workers, no more than 20% on day 1 and no more than 20% increase on each additional day



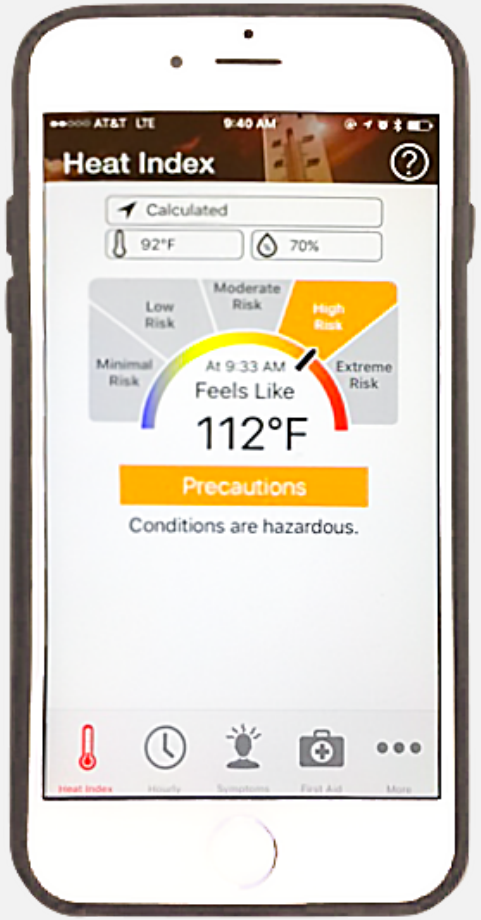
Heat Stress Prevention Program
Heat Acclimation Physiology

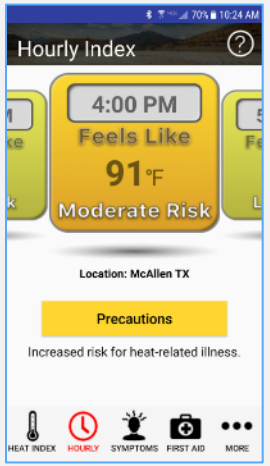
- 2 hours/day of heat exposure needed
- Sweating: earlier onset, greater production and lower electrolyte concentration
- Stabilization of circulation
- Decreased heart rate, lower core temperature with activity

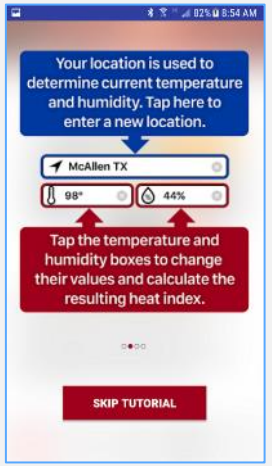


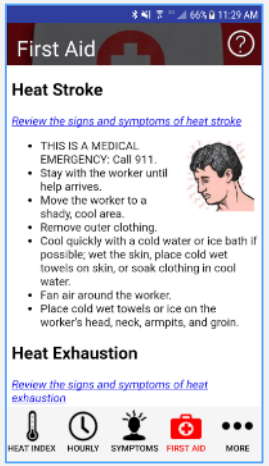
Source: Scand J Med Sci Sports 2015. 25 (Suppl 1): 25-38.

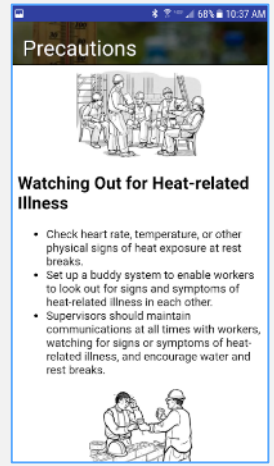
OSHA-NIOSH Heat Safety Tool











Download on the App Store

GET IT ON Google play

Heat Stress Prevention Program
Personal Protective Equipment and Clothing

Preventive PPE considerations:

- Water-cooled garments
- Air-cooled garments
- Cooling vests
- Wetted overgarments

Clothing recommendations:

- Loose fitting
- Light colored
- Light-weight
- Long sleeved
  - Sun protection
  - Environment > body temperatures

Heat Stress Prevention Program
Medical Monitoring and Surveillance

Goals:

- Early identification of risk factors that may increase the risk of heat-related illness and signs or symptoms that may be related to heat-related illness for the prevention of adverse outcomes

Medical Opinion:

- Whether the worker has any medical conditions that would increase the health risk of exposure to heat in the work environment.
- Whether the worker is physically fit for the work required by the job
- Recommendations for reducing the worker's risk for heat-related illness

Impact of a Heat-related Illness Prevention Program

Outcomes of a Heat Stress Awareness Program on Heat-Related Illness in Outdoor Municipal Workers

Ronda McCarthy, MD, MPH

Co-Investigators:

Frances S. Shofer, PhD

Judith Green-McKenzie, MD, MPH

University of Pennsylvania, Division of Occupational and Environmental Medicine, Department of Emergency Medicine

Impact of a Heat-related Illness Prevention Program
Outcomes of Heat Stress Awareness Program

Based on exposed workers' responses to questionnaire screening for heat-related illness risk factors

All workers and workers with no identified increased risk:

- Training: heat stress prevention, HRI first aid, emergency response procedures
- Acclimatization plan

Workers at higher risk for heat illness:

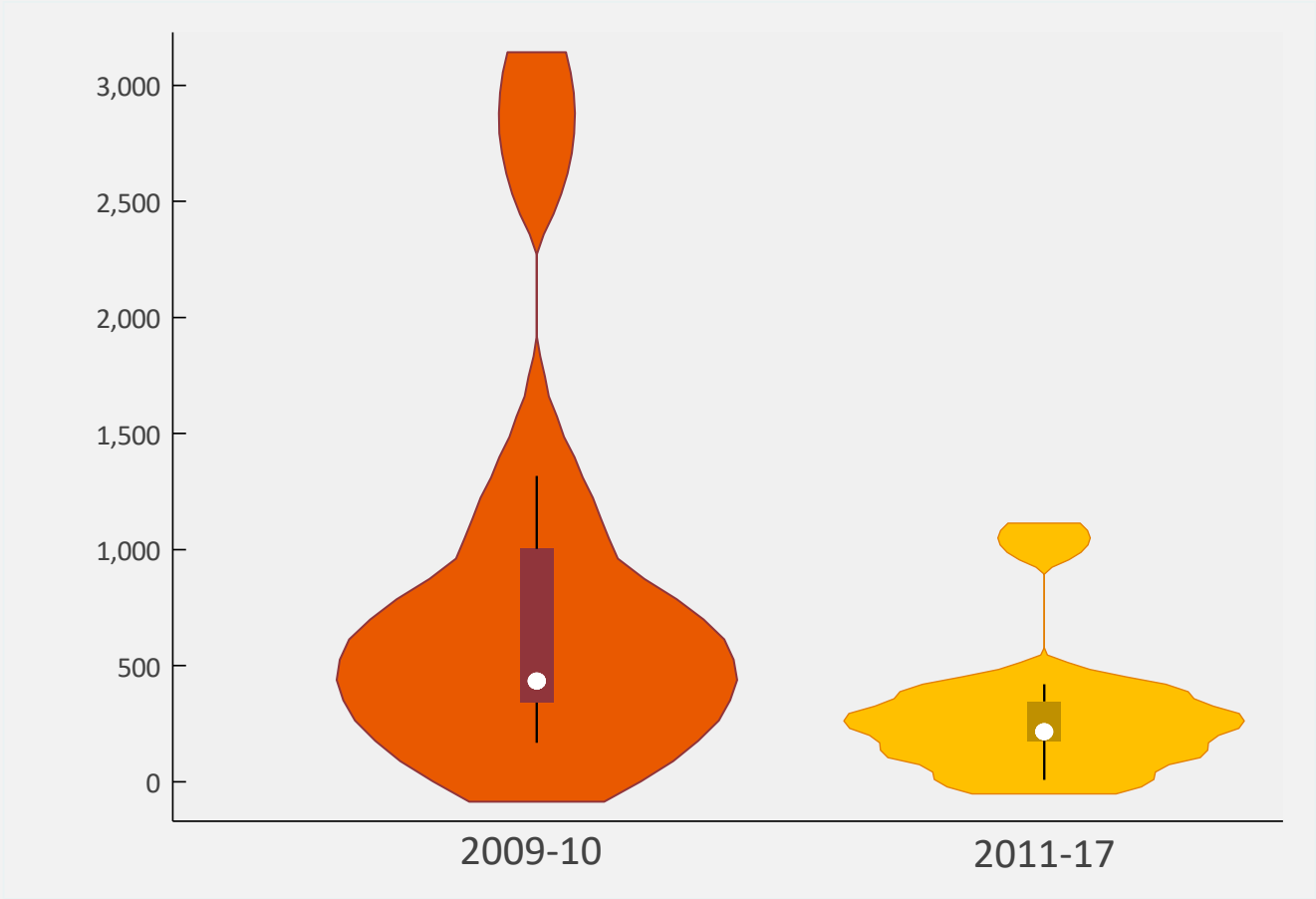
- Medical monitoring with RN and/or,
- Medical monitoring exam with physician
- Individualized HRI prevention training

Workers at highest risk to self or others in hot environment: Restricted from work in hot environments

- Requested health condition addressed by personal physician/specialist
- Once at-risk condition controlled, acclimatization plan to return to work
- Periodic rechecks through hot season offered

McCarthy RB, Shofer FS, Green-McKenzie J. Outcomes of a Heat Stress Awareness Program on Heat-Related Illness in Municipal Outdoor Workers. JOEM. 2019 Sep;61(9):724–8. DOI 10.1097/jom.0000000000001639

Median Costs per Illness: Before and After



Median cost incurred per illness reduced by 50% after program implemented compared to the prior 2 years
p=.0009

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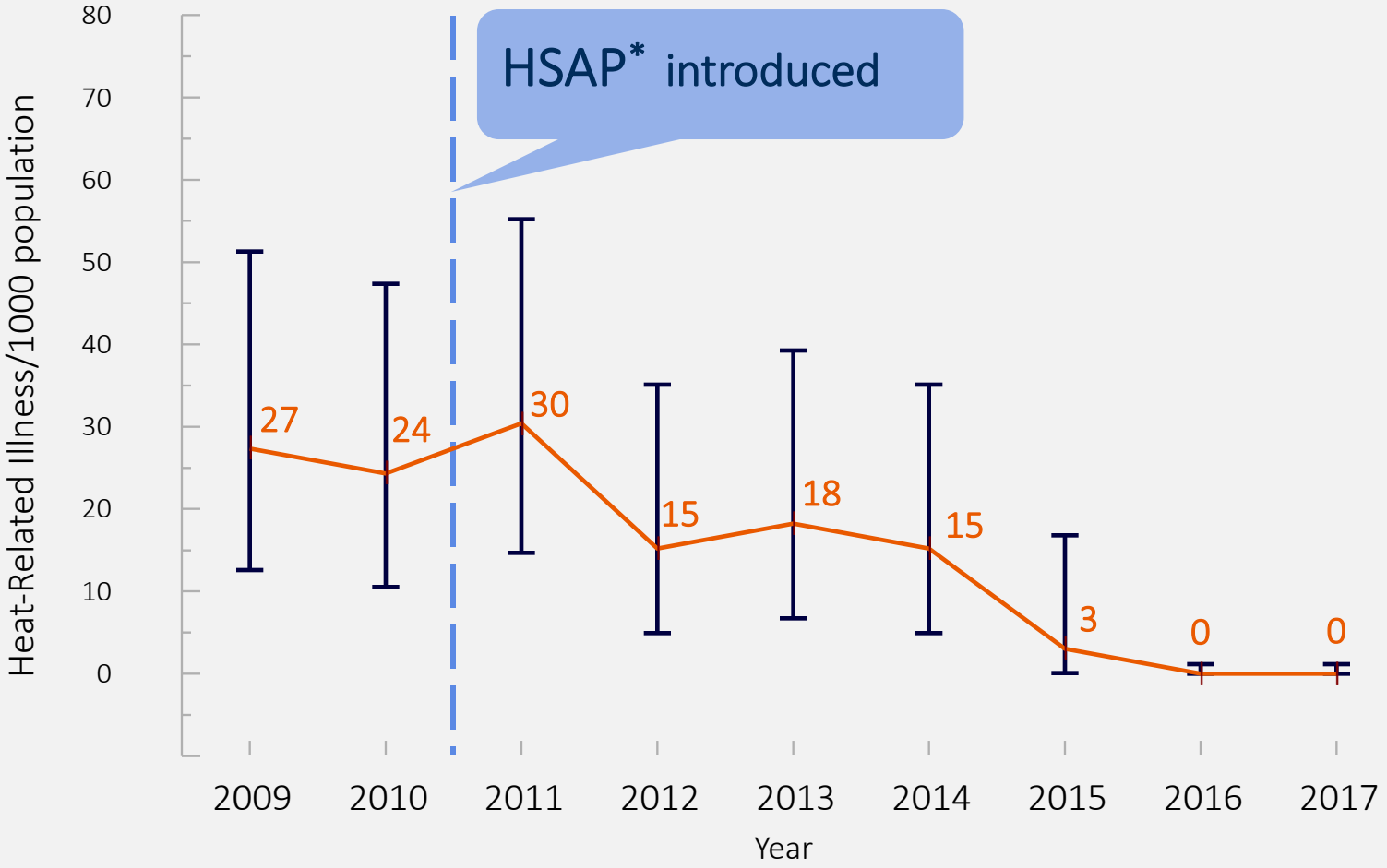
Impact of a Heat-related Illness Prevention Program

Heat-related Illnesses: Before & After Heat Stress Awareness Program*



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Key Takeaways

- Heat-related illnesses and fatalities are preventable.
- Research supports heat illness prevention programs' effectiveness in reducing heat-related illness and associated workers' compensation costs.
- Prepare now to address heat exposure to preserve the health and safety of your vulnerable patients.

Resources

Mental Health

www.climatepsychiatry.org/toolkits

- educational material for mental health providers about heat impacts focusing particularly on our psychiatric population
- guidelines/tips for patients or family/caregivers during extreme heat.

CDC/NIOSH

https://www.cdc.gov/niosh/topics/heatstress/
https://www.cdc.gov/niosh/docs/2011-174/

OSHA

http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_4.html
https://www.osha.gov/SLTC/heatillness/heat_index/pdfs/all_in_one.pdf

Thank you!