ACCLIMATIZATION, DECAY AND RE-ACCLIMATIZATION

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  – Dr. Eric Coris
  – Dr. Rebecca Lopez
• Introduction to acclimatization
• Physiological adaptations of acclimatization
• How long to acclimatize?
• What about decay of acclimatization?
• How long to re-acclimatize after absence?
• Acclimatization/Re-acclimatization Guidelines
Exertional heat illness is a risk for workers in hot environments.

<table>
<thead>
<tr>
<th>Unacclimatized n (%)</th>
<th>Fatal illnesses (n=14)</th>
<th>Nonfatal illnesses (n=11)</th>
<th>Total sample (n=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11 (78.6)</td>
<td>1 (9.1)</td>
<td>12 (48.0)</td>
</tr>
</tbody>
</table>

- Decreased heart rate for a given intensity
- Increased plasma volume
- Increased stroke volume
- Increased skin blood flow
• Decreased core temperature for a given workload
• Decreased threshold for the onset of sweating
PHYSIOLOGY OF ACCLIMATIZATION: SWEAT RATE

- Greater sweat rate
- More dilute sweat
- Sweat at a lower core temperature
• Decreased perceived exertion
• Reduced oxygen demand at a given intensity
• Fitness confers an advantage to acclimatization
CURRENT ACCLIMATIZATION GUIDELINES

• Occupational Safety and Health Administration:
  – 5 days beginning with 50%; increase to 100% by day 5

• National Institute for Occupational Safety and Health:
  – 5 days beginning with 20%; increase 20% each day

• Mining Safety and Health Administration
  – 6 days beginning with 50%; increase 20%

• Military guidelines
  – 2 weeks
HOW LONG TO ACCLIMATIZE?

- $n = 18$
- Evidence of acclimatization = plateau in core temperature over last 30 minutes for 3 days
- $\rightarrow$ 6 days for acclimatization
Adaptations in heart rate and core temperature occur in 5 days with daily heat exposure.

– Increased duration of daily heat exposure improves core temperature adaptations.
– Increased WBGT improves sweat rate adaptations.
ACCLIMATIZATION, DECAY AND REACCLIMATIZATION: HEART RATE
ACCLIMATIZATION, DECAY AND REACCLIMATIZATION: CORE TEMPERATURE
For every decay day, ≈ 2.5% of adaptations in heart rate and core temperature are lost.

Rate of decay in core temperature can be reduced with increased duration and decreased exposure.
**RE-ACCLIMATIZATION TO HEAT**

- **OSHA:**
  - 5 days after 2 weeks away

- **MSHA:**
  - 4 days after 8 days away; Beginning with 50%

- **NIOSH**
  - 4 days begin with 50%
RE-ACCLIMATIZATION TO HEAT

- Research:
  - 4 days after 2 weeks away
  - 5 days after 4 weeks away
• Heat stress is based on:
  – Environmental conditions
  – Metabolic rate
  – Clothing
## Recommendations for Heat Acclimatization for Warm Conditions

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Time Spent working in hot environment</td>
<td>Heat Acclimatization Days</td>
<td>Time Spent working in hot environment</td>
</tr>
<tr>
<td>78–81.9</td>
<td>90–100%</td>
<td>2–3</td>
<td>70–100%</td>
</tr>
<tr>
<td>82–84.9</td>
<td>80–100%</td>
<td>2–4</td>
<td>70–100%</td>
</tr>
<tr>
<td>85–87.9</td>
<td>70–100%</td>
<td>3–5</td>
<td>60–100%</td>
</tr>
<tr>
<td>88–89.9</td>
<td>60–100%</td>
<td>4–6</td>
<td>50–100%</td>
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<tr>
<td>90+</td>
<td>50–100%</td>
<td>6</td>
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# Re-Acclimatization Guidelines According to Temperature and Work Rate

## Recommendations for Re-Acclimatization for Warm Conditions

<table>
<thead>
<tr>
<th>Routine Absence</th>
<th>Absence Due to Illness</th>
<th>Day 1</th>
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<th>Day 3</th>
<th>Day 4</th>
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<tr>
<td>&lt; 4</td>
<td>--</td>
<td>100</td>
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<tr>
<td>4 - 5</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<tr>
<td>12 - 20</td>
<td>6 - 8</td>
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<tr>
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**GREEN**

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**YELLOW**

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**RED**
CONCLUSION

• Establishing heat acclimatization policies is crucial in ensuring worker safety.
• Adaptations of acclimatization can be accrued in 5 to 6 days with greater benefits with longer exposures.
• Acclimatization is lost when workers are away from the heat, and a re-acclimatization schedule is warranted.
• Prudent acclimatization and reacclimatization guidelines should take into account environmental conditions and work rate.
THANK YOU FOR YOUR TIME!