13. Health Impacts in Vulnerable Groups

Panel: Chelsea Ducille, Barrett LaRussa, Deep Kiran, Ravish Bharwaj

Primary Air Care: Setting the agenda
Global action to build sustainable energy systems and reduce emissions of greenhouse gases and hazardous air pollutants
Friday, April 19, 2019 – Olin Hall, Homewood Campus, Johns Hopkins University
Why discuss extreme heat in a symposium on air pollution?

1. Extreme heat and air pollution interact to produce worse health outcomes. Both are prime examples of health inequities.

2. Patterns of fossil fuel use contribute to both through emissions of greenhouse gases and air pollutants.

3. Links between interventions, co-benefits of interventions
   - Potential to integrate preparedness and response for air pollution and heat emergencies
   - Greening interventions reduce both heat and pollutants
   - Heat action plans and air pollution action plans have some many common elements, some potential for integration
Session 13 Objectives

- Present current research being done on extreme heat and its effects on human health, especially for vulnerable groups
- Describe the range of interventions for prevention, preparedness and response to heat
- Identify opportunities for research on interventions to reduce the effects of heat and air pollution, improve clinical care for heat and air pollution
Heat Emergency Awareness Treatment (HEAT)

Chelsea Ducille
Senior Research Program Coordinator, Dept. of Emergency Medicine Research, School of Medicine
Heat Emergency Awareness Treatment (HEAT)

A cluster randomized trial to assess the impact of a comprehensive intervention to mitigate humanitarian crisis due to extreme heat in Karachi, Pakistan
Background

- Heat waves responsible for second highest number of deaths due to natural disasters after storms
- Projected EH exposure will increase as climate change becomes more pronounced
- City dweller at significantly greater risk of EH exposure
- Developing countries lag in planning and response to heat-related illness
- No trial on the community and hospital based response to heat crisis in developing countries
Heat Island Effect in Urban Areas
Research Questions

• How can the burden of heat emergencies be reduced?
• Can a comprehensive intervention focusing on community-based adaptive strategies and improved emergency healthcare in a low resource urban setting lead to a reduction in emergency department visits, hospitalization and total mortality?
Objectives/ Specific Aims

1: To develop evidence based care strategies for management of people with exposure to extreme heat (EH) in both households and emergency departments in low income settings such as Pakistan (Heat Emergency Education and Training Bundle)

2: To implement Heat Emergency Education and Training (HEAT) bundle in Karachi and measure its impact on a composite outcome comprising of emergency department admissions, hospital admissions and all-cause mortality

3: To determine the impact of HEAT implementation on the knowledge and care practices in households and emergency departments.
Methodology

- Design: Cluster Randomized Trial (Community-based) and Pre/Post Study (Hospital)
- Setting: Korangi, Karachi, Pakistan
Study Sites
Korangi: population of one million
Ibrahim Hyderi: population of 150,000
Community Component

- Phase 1: Baseline data
  - May-Jul, 2017, baseline community surveillance

- Phase 2: Community Awareness Interventions/Activities (Jan-Apr 2018)
  - Community mobilization: Targeting community leaders, schools, mosques – Each CHW conducts 2 sessions in March/April, 2017 and work with CBOs. CHW trained in 2 hour sessions. Half a day Master trainer workshop
  - SMS with health messages; Aman Tele-health to be used for any questions
  - Pamphlets/flyers – activity to be conducted twice during summer months targeting schools and mosques

- Phase 3: Post-Intervention data collection (May-Sep 2018)
  - KAP survey (before and after)
  - Hospital admissions and deaths in the community (before and after)
  - Recall of SMS messages
Study Design – Hospital Arm

• What is the setting of our study?
  – Four major hospitals in/close to the Korangi District
  – The hospitals will be randomized to receive operations and clinical capacity building on management of heat emergencies.

• Our intervention
  – Development of heat emergency management protocol
  – Training of emergency physicians and nurses through a one day workshop
  – Placement of protocols in emergency department resuscitation areas

• What are we measuring
  – Pre and post test of knowledge of physicians and nurses
  – Number of admissions with suspected heat emergency to the emergency department and to the hospital
  – Number of deaths due to suspected heat emergencies
  – Review of quality indicators for suspected heat emergency patients
  – KAP survey
## Baseline data – Community/Household characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of households</td>
<td>2712</td>
</tr>
<tr>
<td>Population covered</td>
<td>16973</td>
</tr>
<tr>
<td>Avg HH size (# of people/house)</td>
<td>6.3</td>
</tr>
<tr>
<td>Avg number of rooms/house</td>
<td>1.8</td>
</tr>
<tr>
<td>Windows in every room</td>
<td>90.10%</td>
</tr>
<tr>
<td>Tap water available</td>
<td>54.10%</td>
</tr>
<tr>
<td>Uninterrupted water supply</td>
<td>27.70%</td>
</tr>
<tr>
<td>Electric power available</td>
<td>89%</td>
</tr>
</tbody>
</table>
# Baseline data – Hospitals

<table>
<thead>
<tr>
<th></th>
<th>Total ED visits</th>
<th>Total Admissions</th>
<th>Total DOA/ED deaths</th>
<th>Total patients recruited</th>
</tr>
</thead>
<tbody>
<tr>
<td>JPMC</td>
<td>106813</td>
<td>16489</td>
<td>1208</td>
<td>1419</td>
</tr>
<tr>
<td>Chiniot</td>
<td>16336</td>
<td>2972</td>
<td>52</td>
<td>325</td>
</tr>
<tr>
<td>Korangi</td>
<td>59390</td>
<td>1088</td>
<td>469</td>
<td>1534</td>
</tr>
<tr>
<td>Indus</td>
<td>40058</td>
<td>2314</td>
<td>182</td>
<td>915</td>
</tr>
<tr>
<td>Total</td>
<td>222597</td>
<td>22863</td>
<td>1911</td>
<td>4193</td>
</tr>
</tbody>
</table>
Hospital- & Community-Based Literature Reviews - Objectives

- Literature reviews conducted to contribute to the overall objectives of the project
  - To develop evidence-based care strategies for management of people with exposure to extreme heat in both households and EDs in LMIC
- Determine if there are existing interventions and programs for the management and prevention of heat-related illnesses (HRI)
- Investigate the most effective cooling methods for individuals experiencing HRIs
Discussion

- Research in limited
  - Only reviewed articles published in English
- Vulnerable populations (children, elderly, those living in slum) should be targeted for interventions
- Government and NGO capacity for preparing for and responding to extreme heat events can improve outcomes
- Most articles, though different in their approach, employed multi-level interventions
### Results - Hospital Cooling Modalities

<table>
<thead>
<tr>
<th>Author</th>
<th>Comparison of Cooling Methods</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kielblock et al., 1986</td>
<td>Instant cooling packs vs. passive cooling</td>
<td>Instant cooling packs not effective compared to passive cooling</td>
</tr>
<tr>
<td>Wyndham et al., 1959</td>
<td>Evaporative cooling vs. ice water immersion</td>
<td>Evaporative cooling &gt; ice water immersion</td>
</tr>
<tr>
<td>Khogali and Weiner et al., 1980</td>
<td>Evaporative cooling vs. ice water immersion</td>
<td>Evaporative cooling &gt; ice water immersion</td>
</tr>
<tr>
<td>Channa et al., 1990</td>
<td>Dantrolene drug IV vs. placebo</td>
<td>Dantrolene not effective compared to placebo</td>
</tr>
<tr>
<td>Bouchama et al., 1991</td>
<td>Dantrolene drug IV vs. placebo</td>
<td>Dantrolene not effective compared to placebo</td>
</tr>
</tbody>
</table>
Conclusion

- Evaporative cooling found to be a commonly used technique with support from the literature
  - Evaporative cooling found to be significantly more effective compared to passive cooling and use of ice packs
  - Two articles found evaporative cooling to be significantly more effective than ice water immersion
- Literature does not support the use of IV fluids or pharmacological management for HRIs
- There is not enough literature to support the use of combined methods of cooling
To Date

• Completed
  - Community and hospital surveillance
  - Baseline and endline data collection
  - KAP survey
  - Development of community and hospital interventions
  - Tool implementation/Intervention
  - Stakeholder meetings
• Ongoing
  - Data analysis
  - Manuscript writing
Acknowledgements

• Dr. Nadeemullah Khan (AKU)
• Dr. Uzma Khan (AKU)
• Dr. Saadia Quraishy (Aman)
• Mr. Zaheer Chand (Aman)
• Mr. Altaf Musani (Aman)
• Mr. Naved Ahmad (AKU)
• Ms. Chelsea Ducielle (JHU)
• Ms. Mary McBride (JHU)
• Ms. Olga Grant (JHU)
• Dr. Portia Chipendo
• Dr. Valerie Osula
• Dr. Julio DeJesus
• Fariha Hasan
• Munira Jamali
• Joshua St. Rose
• Shayan Marsia
Scoping Review of Interventions for Extreme Heat

Barrett LaRussa, Deep Kiran, Ravish Bhardwaj
MPH Candidates, Bloomberg School of Public Health
Rationale for scoping review on interventions to reduce heat / reduce health impacts of extreme heat

- **Situation** in many low and middle-income countries (LMIC):
  - No policies or interventions are in place to address heat
  - No government officials are responsible for extreme heat
  - Many LMICs will experience/suffer from extreme heat more than HICs

- **Goal**: Develop menu of interventions to reduce the health impacts of extreme heat events, with data on effectiveness & guidelines for implementation, for policymakers, environmental NGOs, donors, and other partners

- **Global review**: High, middle and low-income countries
  - Some intervention modalities have only ever been implemented in high-income countries
  - BUT: Also lessons from LMIC for high-income countries
Search Strategy and Methods

Identifying Relevant Studies

Databases searched: PubMed, Scopus & Embase

Relevant articles were categorized into:

**Group 1**: Interventions to reduce heat-related health burden during extreme heat

**Group 2**: Greening interventions to reduce heat

Study Selection

- **Inclusion Criteria**:
  - Interventions directly reducing urban heat
  - Interventions reducing acute impacts of heat on human health

- **Exclusion criteria**:
  - Not peer-reviewed
  - Interventions address clinical management
  - No quantifiable outcomes
  - Outcome is behavior, perception
  - Modeling/simulation studies
# of records identified through database searching (N=11,293)

# of records after duplicates removed (N=8,175)

# of records screened at first level (three people) (N=8,175)

# of titles/abstracts screened at second level (three people) (N=1,485)

# of citations excluded (N=6690)

# of citations excluded (N=5205)

# of intervention articles screened to determine eligibility (two people) (N=980)

# of greening articles screened to determine eligibility (one person) (N=588)

# of full-text articles retrieved to determine eligibility (N=80)

# of full-text articles retrieved to determine eligibility (N=70)

# of articles included in the scoping review (N=14)

# of articles included in the scoping review (N=14)
Heat Plans: Comprehensive Plans

- Establish and trigger actions to reduce health effects of extreme heat
  - Partners
  - Protection for vulnerable groups
- Eight studies reviewed
  - France (1), Italy (2), Spain (1), Switzerland (1), Germany (1), USA (1), Australia (1)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention may reduce at least 1 negative health outcome, but could be due to other factors</td>
<td>6</td>
</tr>
<tr>
<td>Intervention not effective</td>
<td>1</td>
</tr>
<tr>
<td>Unable to conclude due to methodological challenges</td>
<td>1</td>
</tr>
</tbody>
</table>

Martínez-Solanas, Basagaña (2019): Spain’s Heat Health Prevention Plan (HHPP)

- Coordinates partners, disseminates information to public, hotline, Autonomous Communities may establish additional measures
- Attributable mortality during potential activation of plan was smaller in period 2 (0.47%, 95% CI: 0.34, 0.58) than period 1 (0.69%, 95% CI: 0.56, 0.80)
- Other factors could explain the reduction
**Stand-Alone Heat Interventions**

- Very little research has evaluated effectiveness of stand-alone interventions (i.e. phone alerts) with a quantifiable outcome.
- One study showed significant risk reduction and better health outcomes after intervention.
- More analysis and research is needed to see cost-benefits and health benefits, and to identify potential confounders.

*Mehiriz, K., et al. (2018) "The Effect of an Automated Phone Warning and Health Advisory System on Adaptation to High Heat Episodes and Health Services Use in Vulnerable Groups-Evidence from a Randomized Controlled Study."

- Evaluate public health impact by Randomized Controlled trial.
- Phone heat warning sent to treatment group a day before a heat episode.
- Quality of heat warning message was also measured.
- Improved adaptation to heat.
- Significant reduction in health services use
Greening Interventions to Mitigate Urban Heat Island

- Preliminary Results:
  - Only 3 out of 14 (21.4%) studies assessed thermal comfort

<table>
<thead>
<tr>
<th>Intervention Type</th>
<th>Number of Studies (N=14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined use of green roofs, cool roofs &amp; green walls</td>
<td>6</td>
</tr>
<tr>
<td>Vegetated Roofs</td>
<td>4</td>
</tr>
<tr>
<td>Green Walls/Facades</td>
<td>2</td>
</tr>
<tr>
<td>Higher albedo roofs</td>
<td>1</td>
</tr>
<tr>
<td>Grass covered parking lot</td>
<td>1</td>
</tr>
</tbody>
</table>

Beaudoin et al. (2016)

- 40 projects were implemented in the province of Quebec
- Projects included greening yards and alleys, white roofs and planting over 3000 trees and 26000 bushes
- Results demonstrated benefits of UHI mitigation measures in terms of heat reduction as well as social benefits
Future Directions

- We have an increasingly elderly population
  - Urban populations are growing
  - Cities can take steps such as these to reduce urban heat island and better respond to people affected by extreme temperatures

- Incorporate into resilience and adaptation plans
- Incorporate into plans to reduce air pollution
- Intervention research and programs to address extreme heat and interactions with air pollution should be greatly expanded
Questions for Discussion

1. How do we combine heat and air pollution interventions given many countries are likely to be dealing with both?

2. What are opportunities for research on interventions to reduce the effects of heat and air pollution on populations?

3. What are opportunities for research to improve preparedness and clinical care for heat and air pollution in routine and emergency settings?