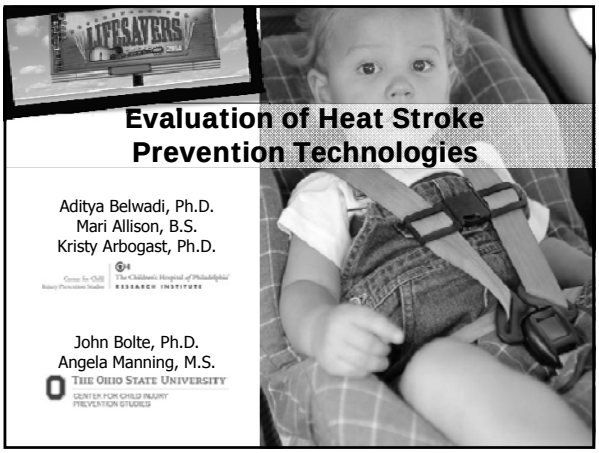

Evaluation of Heat Stroke Prevention Technologies

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CENTER FOR INJURY RESEARCH AND PREVENTION

THE CHILDREN'S HOSPITAL OF PHILADELPHIA RESEARCH INSTITUTE

Dedicated to advancing the safety of children, youth and young adults through research and action.

- Comprehensive
  From *Before-the-Injury* prevention
  To *After-the-Injury* healing
- Interdisciplinary
  Behavioral science ,clinical care, engineering , epidemiology, public health and communications
- Engaged
  Large network of partnerships with universities, government, industry and non profit sector
- Translational
  Practical tools & recommendations for families, professionals and policymakers

What brings these researchers together?

- Center for Child Injury Prevention Studies (CChIPS) within Center for Injury Research and Prevention at CHOP
- Translational research within an industry/ academic cooperative
  - Come together to determine technological solutions to child injury
  - For this study - CHOP, Ohio State University, and NHTSA

Introduction

- Heatstroke occurs when the body is unable to dissipate the heat that it produces and absorbs
- Annual average of 38 child fatalities due to automobile-related heatstroke
- Marked increase in 1998 (21 fatalities in 1997) with steady rate ever since

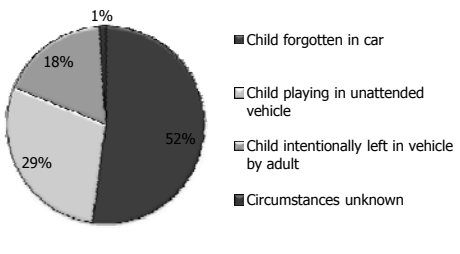
Causation

- Hyperthermia ≠ fever
- In hot environment (enclosed car)
  - Conduction, convection and radiation cease
  - Evaporation (sweating) becomes primary means of cooling
- Children have reduced thermal regulation effectiveness
- Infants may be fully dressed and strapped into padded CRS which exacerbates problem of reduced heat dissipation

http://www.ggweather.com/heat/

44 Deaths from Heatstroke in 2013

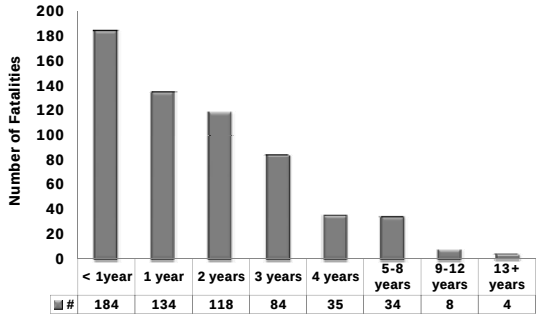
- Compared to 49 child deaths in 2010



605 deaths – 1998-2013

2 deaths already in 2014

Age of Children (1998-2013)



	< 1year	1 year	2 years	3 years	4 years	5-8 years	9-12 years	13+ years
#	184	134	118	84	35	34	8	4

Project Goals

- To evaluate countermeasures designed to prevent children 0 to 24 months of age from being left behind in closed, parked vehicles, which has the potential to result in heatstroke
  - Effectiveness of the countermeasures in determining the presence of a child
  - Alerting the caregiver
  - Influencing the behavior of the caregiver

Project Goals

- To conduct Focus Groups with parents to assess perceptions around the issue of heatstroke deaths in children in hot cars
  - Also sought opinions on currently available heatstroke injury prevention technologies

Tasks

- Assess effectiveness of countermeasures
  - Does the system successfully recognize the presence of children of different sizes, ranging from 0 to 24 months of age?
  - Is the system compatible with a range of child restraints?
  - Does the system successfully notify the responsible party of the presence of the child?
  - Is the system dependent on the location of the alarm (e.g. on the key fob or on the child seat) and/or the location of the responsible party (e.g. inside of the car, outside of the car)?
  - Does the system successfully prevent the caregiver from leaving the child in the child seat?

Methods

- Determine products' sensing limits and ability to detect a child versus items of similar weights.
- Assess the effect of the following parameters on the products' sensing ability
  - Misuse scenarios
  - Interference – concrete wall, other device, cell phone
  - Spilled liquids
  - Typical commute (i.e. associated time and child shifting)
- Assess the effectiveness of the notification method of each device.

Evaluation Methodology

- Four restraints
  - Convertible seats evaluated both rear facing/forward facing
  - Infant seat evaluated with and without base

Safety 1st Complete Air 65

Priori Maxi Cosi

The First Years True Fit

Chicco Key Fit infant child seat

Evaluation Methodology

- Identified 17 devices in the market (2012)
  - Tested three in detail
- Four inanimate objects
  - Backpack – 11 lbs
  - Sandbag – 22 lbs
  - Doll – 6.5 lbs
  - Doll – 27.5 lbs

Human subject methodology

- Children restrained in child restraints instrumented with heatstroke prevention device – **CHOP IRB Approved Protocol**
  - Rear row of 2006 Chrysler Town and Country
  - Three subject groups
    - **0-6 months,** 3.5-6.0 kg – Chicco Key Fit Infant Restraint
      - n=1
    - **9-15 months,** 9.6-11.1 kg – >9 subjects – one of three convertibles RF
      - n=5
    - **21-27 months,** 11.8-13.6 kg – >9 subjects – one of three convertibles FF
      - n=2

Between 25th and 75th percentiles

Human subject methodology

- Static Assessment
  - Parent in front passenger seat
  - Child restraint attached via LATCH in right rear seat
  - Vehicle and air conditioning (if needed) turned on
  - One of the three heatstroke prevention devices installed in child restraint
  - Device armed, wait 5 minutes – record any errors
  - Investigator walked away from vehicle with key fob, noted whether alert goes off and at what distance
  - Repeat with other two heatstroke prevention devices

Simulated commute

- Each subject tested one restraint with one heatstroke prevention device
- Steps Involved
  1. Child restrained in rear seat, parent in front seat, investigator 1 in rear seat next to child
  2. Device synched
  3. Investigator 2 drove pre-determined route for 25 minutes
  4. Investigator 1 encouraged "wiggling" of child during drive
  5. Return to starting point
  6. Investigator 1 walked away from vehicle with key fob, note whether alert goes off and at what distance

Project Goal – Focus Groups

- To evaluate the impact and acceptance of available technologies to prevent children from being left in closed vehicles.
- Specific Aims:
  - Develop focus group plan for surveying current and expecting parents
  - Identify perception of:
    - Scope of problem
    - Need for countermeasure
    - Value and effectiveness of current countermeasures

Methods – Focus Group Design

- (4) total focus groups
  - (2) in Columbus, OH : Large capital city
  - (2) in Dayton, OH : Smaller rural city
- 60 minutes in length
- Participant incentives - $25 Speedway gas cards
- Handout with follow-up information provided to address any concerns not answered

Summary of Focus Group Findings

- Key to prevention is awareness of child in vehicle
- Participants unaware of what causes heatstroke
  - General ***lack of knowledge of conditions*** that lead to heatstroke
- Public knowledge of ***scope of problem is unclear***
  - Participants do not know frequency of problem

Technology Assessment Conclusions

- All technologies – CRS based
  - Will not address children who gain access to the vehicle or are not in child restraints (20-40%)
- All sensing technologies are active
  - Require purchase - $70 minimum – more for add'l key fobs, etc.
  - Require installation – opportunity for misuse
  - Require transfer of key fob between caregivers
  - Require action by caregiver to correct situation once notified
  - None directly address the hot environment

Technology Assessment Conclusions

- Primary limitation of devices evaluated
  - Synching not consistent – synching/unsynching or beeping during driving can be a distraction
- Evaluation of these products must be comprehensive
  - Methodology laid out in this study provides guidelines for evaluation
  - Must include laboratory and real world assessment

Discussion

- Technologies may lead to ***false sense of security*** for leaving children in vehicle
- No public interest in purchasing additional technologies
  - Combine with CRS and/or vehicle
- ***Educational campaigns*** call for awareness
- Laws may also raise awareness
  - Focus on ***punitive action*** instead of regulation (such as requiring CRS to have built in technologies)

Principles of Public Health

- Caregivers must recognize the need for behavior change – EDUCATION!
- Passive interventions often most effective – no/limited action by individual
- Intervention must address the root cause, ie; TEMPERATURE

Campaigns

- Precautionary measures such as making a habit of looking in the vehicle – front and back – **before locking the door and walking away**;
- Asking the **childcare provider** to call if the child does not show up for care as expected
- Do things that **serve as a reminder** a child is in the vehicle, such as placing a **cell phone, doll, purse or briefcase in the back seat to ensure no child** is accidentally left in the vehicle.
- It's also important that parents and caregivers **teach children** a vehicle is not a play area and store keys out of a child's reach.

- **Stay current with the research**
  - **Injury.research.chop.edu**
    - –Subscribe to *Research in Action* Blog
  - **Cchips.research.chop.edu**

Acknowledgments

- The National Highway Traffic Safety Administration (NHTSA) for funding the study

NHTSA
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

- Center for Child Injury Prevention Studies (CChIPS) at the Children's Hospital of Philadelphia

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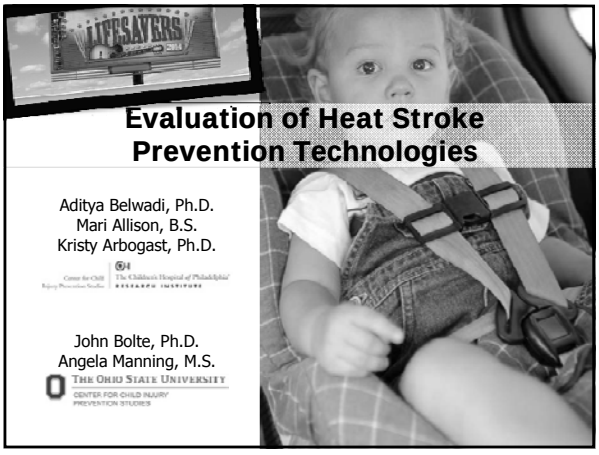

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Methods – Focus Group Design

- Focus Group Questions:
  1. What perceptions do you have about the problem of parents leaving children unattended in hot cars?
  2. From your perspective, how serious of a problem do you think this is?
  3. What do you think is the best way to prevent this from happening?

Methods – Focus Group Design

- Focus Group Questions:
  4. The available prevention technologies fall into two broad categories: Lower cost, which require the caregiver to remember to do something, and higher cost, which operate automatically. How useful do you think these kinds of technologies are? (A handout of available technologies was provided.)
     a. Which prevention technology seems like it would work best and why?
     b. How much would you be willing to pay for this kind of technology and why?

Methods – Focus Group Design

- Focus Group Questions:
  5. If an educational campaign was conducted to prevent these kinds of incidents from happening, what kinds of messages would resonate most with you?
  6. How do you feel about laws and regulations aimed at preventing these occurrences?