Functional Assessment of Unattended Child Reminder Systems

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NHTSA Vehicle Safety Research
Child Fatalities

- 1,149 child traffic fatalities in 2013 in the U.S. \(^1\)
- 44 child heat stroke fatalities in parked vehicles in 2013 \(^2\)

\(^1\) DOT HS 812 154
\(^2\) Data gathered from noheatstroke.org

Safer drivers. Safer cars. Safer roads.
Emphasis has been on education and awareness
- Aimed at parents, caregivers, day care providers, general public
- 2014 and 2015 saw reduction in heat stroke fatalities

Technology has been in marketplace - began to study in 2011
- Interested in understanding capabilities and performance
- CHOP report released in 2012 - surveyed marketplace and performed product evaluations
What are the circumstances?

Child Vehicular Heat Stroke Deaths by Circumstance

Source: Null (2016) personal communication
Scope of Procedure

- Intended for systems that provide reminders to prevent forgotten child
  - Covers largest subset of cases
  - Available products
- Focus on dominant age range
  - CRS-seated children
- Exclude misuse conditions
- Must detect child presence
- Add-on and integrated systems

Cumulative Distribution of Forgotten Child Heat Stroke Deaths by Age

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Purpose of Functional Assessment

- Objectively identify presence of key functions
- Document product repeatability
- Provide consumers information about system capabilities
- Facilitate objective comparisons among different systems
Key Considerations

- Child sizes – range from 0 months to 3 years
  - Only use applicable sizes based on CRS type
- Method of detecting child presence
- Steps for activation
- Extent of confirmation to user
- Issuance of notifications/alerts
  - End-of-trip
  - Left-behind
- Smartphone integration
Child surrogates – ATD (or equivalent) or human
  – Newborn (CAMI)
    • 49.7 cm length
    • 3.5 kg
  – 12 month old (CRABI-12)
    • 74.0 cm length
    • 9.8 kg
  – 36 month old (H-III3C)
    • 94.1 cm height
    • 14.1 kg

Suggest range of CRS types and models, as applicable
Applicable Configurations

<table>
<thead>
<tr>
<th>Surrogate age/size</th>
<th>Infant Carrier</th>
<th>Convertible</th>
<th>Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>RF</td>
<td>RF</td>
<td>n/a</td>
</tr>
<tr>
<td>12 month old</td>
<td>RF</td>
<td>RF</td>
<td>n/a</td>
</tr>
<tr>
<td>36 month old</td>
<td>n/a</td>
<td>RF</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>n/a</td>
<td>FF</td>
<td>FF</td>
</tr>
</tbody>
</table>

RF=rear-facing, FF=forward-facing
Install/Setup

• Procedure assumes proper installation and setup of all required components of a reminder system
  – Placement of sensor in CRS
  – Replacement of harness clip
  – Connection to vehicle electronics
  – Installation of smartphone app

• Procedure does not evaluate installation per se, but sensor placement in CRS proved to be troublesome
Summary of Evaluations

• Child presence repeatability detection
  – Does system audibly confirm detection?
  – Does the user need to perform additional actions?

• End-of-trip notification
  – Does system issue notification at end of trip?
  – What happens when child is removed?
  – Does the user need to perform additional actions?

• Left-behind alert
  – Does system issue alert if child left behind?
  – What happens next?

• Mid-trip deactivation
  – What happens if child gets out of seat during trip?
Products

ChildMinder Elite Pad
(pad placed in CRS, dedicated fob)

Suddenly Safe ‘N’ Secure
(pad placed in CRS, dedicated fob)

 Forget Me Not [iRemind Car Seat Alert]
(pad placed in CRS, smartphone-linked)

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Products

TrueFit iAlert C685
(CRS with sensors, smartphone-linked)

ChildMinder SoftClip
(harness clip transmitter, dedicated fob)

Aviso Child-in-Car Alert
(sensor strip for CRS, linked to vehicle horn)

SOS [Evenflo SensorSafe]
(harness clip transmitter, OBDII receiver)
## Results

<table>
<thead>
<tr>
<th>Table 10: UCRS comparison</th>
<th>Aviso</th>
<th>ChildMin der Elite Pad</th>
<th>ChildMin der SoftClip</th>
<th>Forget Me Not</th>
<th>SOS</th>
<th>Suddenly Safe ‘N’ Secure</th>
<th>True Fit I-Alert</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Audible Presence Detection Confirmation</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>User Action Required for Activation</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>User Action Confirmation</strong></td>
<td>n/a</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>n/a</td>
<td>Yes</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>End-of-Trip Reminder Notification</strong></td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes²</td>
</tr>
<tr>
<td><strong>Audible Child Removal Notification</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>End-of-Trip User Action Required</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Left-Behind Notification</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Left-Behind Notification Recipients</strong></td>
<td>Vehicle surroundings</td>
<td>User (fob)</td>
<td>User (fob)</td>
<td>User (smartphone)</td>
<td>n/a</td>
<td>User (fob)</td>
<td>User (smartphone), Telecommunication (email, SMS)</td>
</tr>
<tr>
<td><strong>Left-Behind In-Vehicle Cancellation</strong></td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>n/a</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Snooze Function</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>n/a</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Limitations

- May not accommodate all possible technologies
- Generality of procedure requires technician judgment
- Does not address effectiveness of notifications once issued
- Simulates idealized circumstances
- Selected occupant sizes may not be appropriate for all designs
Conclusions

- Developed generalized functional assessment procedure
- Available systems differ in capability and user experience
- Systems should ideally include these features
  - No effect on CRS crash performance
  - Minimal additional user action
  - Provide feedback to indicate proper function
  - Provide end-of-trip convenience reminder and left-behind alert
  - Incorporate fail-safe features
  - Exhibit robust operating capabilities - battery life, temperature range, child size, CRS compatibility
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