

DEPARTMENT OF INDUSTRIAL RELATIONS

**Division of Occupational Safety and Health**

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Date: October 18, 2007

To: Len Welsh, Acting Chief  
Department of Industrial Relations  
Division of Occupational Safety and Health (DOSH)From: Janice Prudhomme, DO, MPH  
Public Health Medical Officer II CDHS/OHB

A handwritten signature in blue ink that reads "Janice Prudhomme DO, MPH".

Amalia Neidhardt, MPH, CIH  
Senior Industrial Hygienist  
DOSH Research & Standard Health Unit  
*Original signed by Amalia Neidhardt*

Subject: Cal/OHSA investigations of Heat-Related Illness 2006

**SUMMARY:**

On July 27, 2006, Cal/OSHA's Heat Illness Prevention Standard, T8 CCR §3395 (§3395), became effective for outdoor workplaces in California. The purpose of this present report is to provide updated information about heat illness prevention from data collected during 2006 DOSH enforcement investigations of heat-related illness (HRI) cases. In 2006, Cal/OSHA staff conducted 38 investigations involving heat-related allegations and confirmed 46 HRI cases. The industries with the highest number of HRI cases were agriculture and construction, but cases occurred in several other industries. Despite the higher number of observed HRI cases in 2006, fewer fatalities were observed when compared with 2005. More serious HRI was again observed in Hispanic male workers, which may suggest a need to improve outreach efforts to this subset of workers. We continue to observe HRI cases occurring with extreme temperature but also across a broad spectrum of temperatures and environmental conditions. Over half of the investigations involve work tasks that were reported as strenuous. The combination of inadequate acclimatization and the significant environmental impact of an unusual heat wave in July 2006 contributed to the high percentage of HRI occurring from July 16<sup>th</sup> through July 28<sup>th</sup>. Acclimatization was found to be an important issue for both new

workers and workers exposed to the added environmental stress associated with heat waves. Eighty-two percent of the observed HRI cases occurred during a period of potentially incomplete acclimatization. CCR T8 §3395 requires employers to train on the importance of acclimatization; yet, this training was lacking in over 75% of the workplaces investigated. Only 8% of investigated workplaces addressed all required training elements of §3395, and supervisor training was lacking in over half of the worksites investigated where a fatality had occurred. Reported employer compliance with other requirements of §3395 identified additional areas to target efforts or enhance interventions. Water was reportedly available, but given that evidence for dehydration was present in 95% of the HRI cases, accessibility to adequate fluid may be limited by certain workplace constraints or structure of work activities. Shade was absent during work tasks in approximately 50% of the workplaces. The availability for shade during breaks was better (78%) but reportedly not always used. Emergency response protocols were not adequately described in over 80% of the investigated workplaces. HRI victims reported common HRI symptoms (weakness, fainting, nausea or vomiting, muscle cramps and unusual behavior), but reporting was not always timely. While it is encouraging that fewer workers died this year, many workers were still hospitalized and suffered multi-organ damage related to HRI. Our findings suggest that further prevention efforts are warranted in order to better protect CA workers against heat-related illness, and we have provided some specific recommendations to help accomplish this goal.

## **GENERAL BACKGROUND:**

During 2006, Cal/OSHA enforcement staff completed 38 investigations (with 46 confirmed HRI cases), related to concerns of heat stress. The 38 investigations included both accident and complaint related allegations, and the recorded HRI cases included both fatal and non-fatal cases. As the numbers suggest, four workplace investigations uncovered greater than one case of HRI. Two employers (one indoor and one outdoor) had four cases each of HRI develop during 2006. In conducting this project, we interviewed field enforcement staff involved in the specific investigations and reviewed associated heat illness prevention evaluation questionnaires (HIPEQs), medical records and coroner and autopsy reports. We have performed preliminary analysis of our data and will summarize our findings in an effort to provide feedback on the status of issues related to compliance of CCR T8 §3395 (the Cal/OSHA Heat Illness Prevention Standard) since its adoption in summer 2006. Although the Cal/OSHA Heat Illness Prevention Standard only addresses outdoor workplaces, we also reviewed (and analyzed as appropriate) the available information from the 5 investigations involving indoor workplaces. In our analysis of 2006 data, we have only included information from the cases where HRI was medically confirmed during the investigation.

### **Demographics of HRI Cases and Workplace Investigations (summarized in Table 1):**

- The HRI cases involved 39 male (85%) and 7 female (15%) workers.
- The mean age of the victims was 42 years old (range 16-79 years old)
- 57% of the cases spoke English as their primary language; 41% spoke Spanish and 1 worker (2%) spoke Vietnamese. White workers represented 52% of the victims, Hispanic workers 44% and Black and Vietnamese workers 2% each.
- Eight heat stress victims (18%) died as a direct result of heat-related injury; three of the fatalities occurred before effective medical was rendered. The fatalities occurred in the following industries: Agriculture (3), Landscaping (2), Manufacturing (1; indoor case) and Retail (2). There were no fatalities attributed to HRI in construction. An additional 19 (42%) workers required hospitalization for greater than 24 hours for HRI. Hispanic workers were disproportionately represented in the fatalities group (50%) and in the victims hospitalized for greater than 24 hours (79%). Eighteen (40%) workers only required treatment in an emergency department. Caucasians represented 86% of the victims requiring only emergency department evaluation and/or treatment.
- Heat illness victims were transported from the workplace by ambulance 70% of the time.

- 60% of the cases occurred exclusively outdoors; 20% involved both indoor and outdoor work and 20% involved exclusively indoor work.
- The following service sectors were represented by our data (38 investigations):
  - Agriculture 29%
  - Construction 21%
  - Manufacturing 16%
  - Service 10%
  - Transportation 8%
  - Landscape 8%
  - Retail 5%
  - Forestry 3%

### **Environmental Factors Present for Outdoor Cases (summarized in Tables 1 and 2):**

- The nature (or intensity) of the work for the 37 outdoor victims was reported as: strenuous 54%, moderate 19% and light 27%.
- Days worked under present environmental conditions gives an estimate of acclimatization. For some workers this number represents the number of days worked for employer; for other workers this represents number of days into heat wave. Since the body must acclimatize to drastic changes in environmental conditions, the numbers of days working for employer is not an accurate measure of acclimatization during a heat wave when workers are confronted with a sudden rise in ambient temperature. The heat-related incident occurred on the first day of work or first day of heat wave for 15% of victims, 1-4 days (30%), 5-7 days (27%), 8-14 days (9%) and greater than 2 weeks (18%)
- The mean ambient temperature for outdoor HRI cases was 100°F with a minimum and maximum temperature of 80°F and 116°F, respectively. The ambient temperature is the temperature at the time of the incident if known, or the high for the day if the exact time of incident is unknown because it occurred after the completion of the workday. For cases with unknown conditions, [www.Wunderground.com](http://www.Wunderground.com) or [www.crh.noaa.gov](http://www.crh.noaa.gov) was used retroactively provide environmental conditions.
- Mean relative humidity was 25% (range 2-50%) and mean wind speed was 6 mph (range 0-15 mph)

### **Workplace Conditions in Outdoor Cases (including elements covered by §3395; summarized in Table 3):**

- Potable water was present in 88% of the workplaces.
- Shade was present during some work tasks in 49% of the workplaces.

- The availability of shade during breaks was present in 78% of workplaces, but workers did not report consistent use of shade for breaks.
- Examples of shade (during work and breaks) included: shade from building shadows (24%), indoor work areas (12%), tree shade (19%), vehicles with air conditioning (23%), umbrellas (12%) and tarps (4%). Limited information was available to determine the effectiveness of the type of shade available. Effectiveness was not specifically evaluated during the investigations.
- In 77% of the investigations, interviewed workers reported that rest breaks could be taken as needed, but interviews suggest that generally workers did not avail themselves of these breaks.
- A written IIPP was present in 94% of the investigations.
- A written heat illness prevention program (HIPP) was available in 36% of the cases. All of the required elements of §3395 were present 8% of the time when a HIPP was available. One of the most common missing elements was emergency procedures.
- Training on the importance of acclimatization was present 21% of the time and a specific protocol to deal with acclimatization was present 6% of the time.
- Supervisor training requirements were met in only 43% of the HRI cases where an outdoor fatality occurred and 65% of cases where an outdoor non-fatal HRI occurred.
- An emergency response plan was adequate in only 12% of the investigations.

**Medical Findings of the HRI Victims (combined outdoor and indoor cases—Tables 2, 3, 4 and 5):**

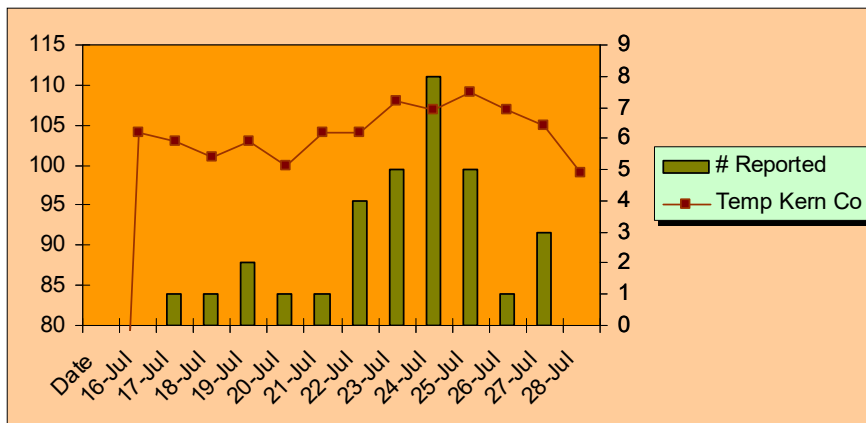
- The victims' mean core body temperature was 102°F (range 97-110)
- Mean heart rate was 117 beats per minute (bpm) (range 55-199; normal 60-100 bpm)
- Evidence for inadequate fluid consumption or dehydration was present in 95% of the cases.
- Common symptoms *reported* included: weakness (41%), fainting (48%), nausea or vomiting (33%), muscle cramps (22%), and unusual behavior (20%). These percentages are when the symptoms were actually *reported*. Lack of reporting does not mean that any given symptom was not present in any of the other cases. See Table 4 for more details.
- Table 5 demonstrates that in cases with available lab data, there is evidence that many organ systems were adversely affected by heat stress. The organs negatively impacted included:
  - Cardiovascular system (heart): 68%

- Kidney 58%
- Muscles 71%
- Blood clotting system 46%
- Stress response/inflammation 34%
- Liver 57-86%
- Acid/base and electrolytes 40-60%
- Brain edema was seen in one case on MRI of the brain
- Medical evidence suggested a pre-existing condition or predisposing risk factor could have contributed to the development of heat-related illness in 44% of the cases.

**DISCUSSION OF THE PRESENTED RESULTS:**

The data we have collected and presented is not comprehensive; however, we feel it provides ongoing valuable information about issues pertaining to HRI, environmental conditions and protective heat standards in occupational settings. The 2006 Cal/OSHA heat-related incidents, accidents and complaints occurred between May-August 2006. This time period was split by employer responsibilities under the emergency heat illness prevention standard, which was effective starting August 22, 2005, and the permanent standard, T8 CCR §3395, which became adopted on June 15, 2006 and went into effect on July 27, 2006. Many of the features in the emergency standard were retained in the final adoption. Our survey tool used for the 2006 investigations closely mirrored what was used in the 2005 investigations. A copy of the utilized heat illness prevention evaluation questionnaire (HIPEQ) is attached to this report. There were more confirmed HRI cases in 2006 when compared with 2005 but thankfully fewer fatalities. We are hopeful that these findings reflect greater awareness generated by the adoption of §3395 and therefore earlier recognition and treatment.

**Importance of the Heat Wave and Acclimatization**

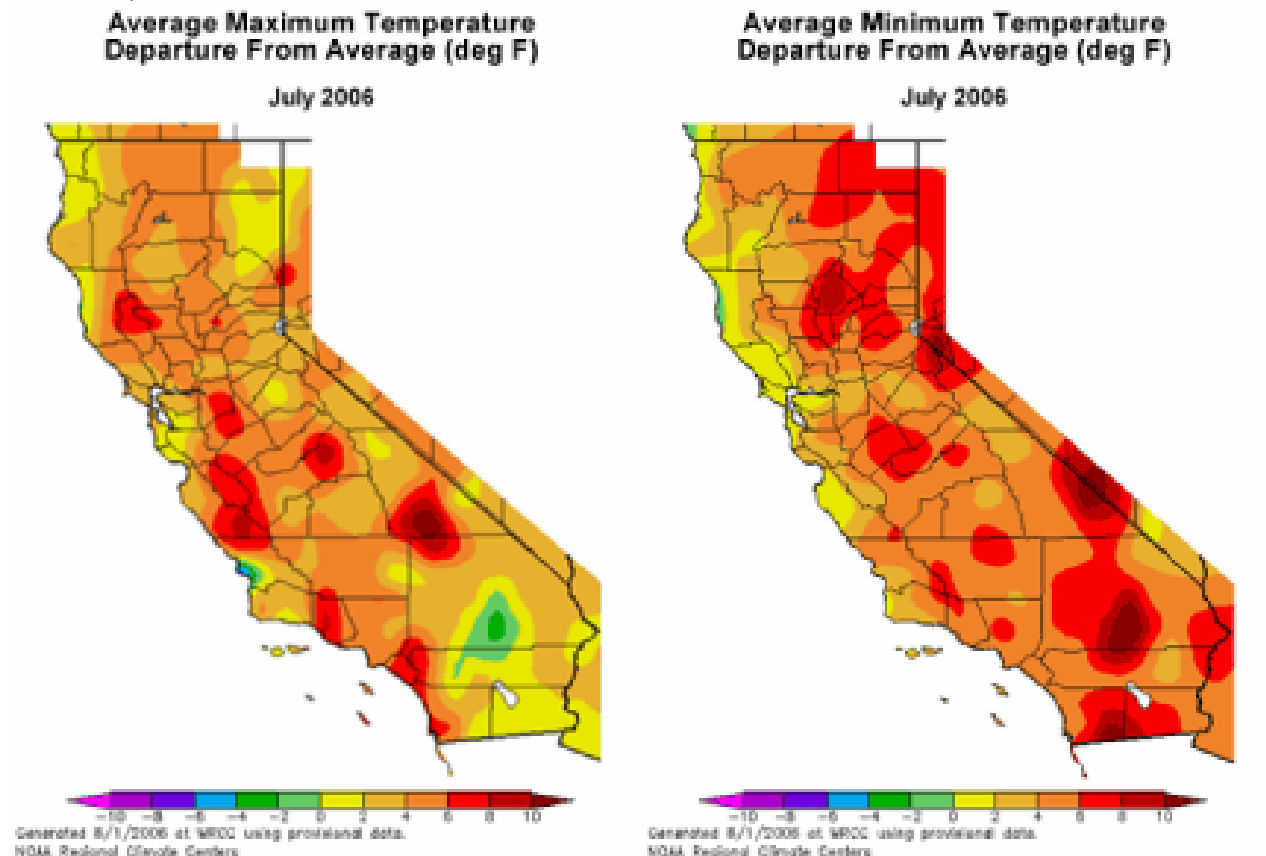


### **Figure 1. Direct Relationship Between Temperature and Number of Reported Cases of HRI**

As displayed in Figure 1, 2006 HRI data clearly shows a strong relationship between heat illness investigations (and HRI cases) and the heat wave that occurred during July 2006. Eighty four percent (84%) of the heat illness cases occurred during this heat wave (July 16-28, 2006). The 2006 heat wave is noteworthy not only because of the days of consecutively high daytime temperatures but also because of the lack of overnight cooling. This situation is depicted below in Figure 2. The lack of an adequate cool down period worked against the recovery from the effects of heat. This point is critical, and it demonstrates that the issue of acclimatization needs to be considered when an employee is new to work AND during a heat wave. Employers need to recognize that a sudden jump in ambient temperature impacts even seasoned workers.

Acclimatization is defined in §3395 as, *“temporary adaptation of the body to work in the heat that occurs gradually when a person is exposed to it. Acclimatization peaks in most people within four to fourteen days of regular work for at least two hours per day in the heat.”* As stated above, the period necessary for acclimatization to fully occur is estimated at 4-14 days.

**Figure 2. Departure from “average” max and min temperature.**



Depicts the departure from average for both the average maximum and average minimum temperature (°F) for July 2006. As one would expect, average maximum and average minimum temperature both exhibited above normal conditions across much of California. In fact, one of the aspects that made the July 2006 heat wave noteworthy was the elevated overnight minimum temperatures, which is reflected well in the right hand image.

Taken from NOAA Presentation on the 2006 Heat Wave:  
[www.wrh.noaa.gov/wrh/07TAs/ta0705.pdf](http://www.wrh.noaa.gov/wrh/07TAs/ta0705.pdf)

Almost 82% of our outdoor cases occurred during this period which suggests that (lack of) acclimatization to the workload coupled with the heat wave may have played an important role in these cases.

This background information on the 2006 heat wave is discussed here to highlight that the extreme conditions played an important role in the development of HRI in 2006. Viewing the information without mention of the heat wave shows that overall our data shows that the environmental conditions present “at the time of incident” in 2006 HRI cases (Table 2) were variable and similar *on average* to those seen in 2005. The mean ambient temperature was 100°F, but HRI cases occurred at temperatures as low as 80°F



and as high as 116°F. This is quite similar to the data presented in 2005. Relative humidity averaged approximately 25% across the heat-related incidents and tends to follow an inverse relationship to temperature (i.e. as temperature increases, relative humidity decreases). This indicates that humidity may play a role in amplifying the effects of heat in certain situations but probably plays a less prominent role in the development of HRI cases in CA as compared to other climates where high heat and high humidity occur simultaneously.

### **Outcome and Demographic Data**

The outcome and demographic data continued to highlight some important points related to workplace HRI. Heat-related illness cases in 2006 were again noted to occur across the work week. There were slightly more cases of outdoor HRI occurring on Mondays (24%) and Tuesdays (19%), but incidents occurred every day of the week, including weekends, which illustrates that the work week for some employees is not the customary Monday through Friday.

Agriculture and construction continue to represent the industries with the highest percentages of investigations (29% and 21%, respectively). Surprisingly 8% of 2006 HRI cases, including two fatalities, specifically involved landscape workers. These landscape workers were generally associated with construction projects. The HRI cases across the industries report doing strenuous work during their exposure to heat stress. Greater than 50% had job tasks defined as strenuous.

In 2006, a higher percentage of English speaking workers are present in the data compared with 2005 (56% vs. 32%). Women also represent a greater percentage than in 2005 (15% vs. 4%). The mean age of the HRI victims was 41 years old, but again spanned a broad age range including younger (16-year-old) and older (79-year-old) workers. Core body temperature values were available for 42 HRI cases in 2006 and averaged 102°F (similar to 2005 data). Pre-existing medical conditions or predisposing risk factors were associated with HRI in 44% of the 2006 confirmed cases.

The outcome statistics show some promising trends when compared with the data from 2005. The outcome results show that despite an increase in the number of workplaces investigated (38 vs. 25 in 2005) and the total number of HRI cases (45 vs. 24), fewer fatalities occurred in 2006 (8 vs. 12). In agriculture alone there were 50% fewer fatalities (3 vs. 6), and the fatalities involved workers of three races (one each Hispanic, Black and Caucasian). In construction there were no fatalities. However, as previously noted above in the “General Background” section and similar to 2005, Hispanic workers were disproportionately affected by serious HRI, comprising the highest percentage of

the fatalities (50%) and the hospitalized victims (89%). Many victims in 2006 (41%) were treated adequately in the emergency room alone. This was particularly true for Caucasian workers as they represented 86% of workers in this category. The need for less treatment hopefully indicates a trend toward earlier awareness, recognition, referral and treatment, but it may also indicate that this improvement affects a select group of workers.

### **Compliance with T8 CCR §3395**

2006 marked the first year of employer coverage under specific Cal/OSHA standards designed to address heat illness protection in the workplace. The investigations suggest that employer compliance with §3395 was found to be sub-optimal in certain areas and adequate in others.

**Water.** Potable water was reportedly present and generally in adequate quantities (adequate supply to meet the quantity/worker specified under §3395). However, as the medical data suggests, dehydration or evidence of inadequate fluid status was present in 95% of the cases where such information was collected. This same inconsistency was present in the 2005 data. Our 2006 data could not adequately capture actual quantities of fluid consumed or how well drinking was “encouraged” by the employer as required by §3395. This concept of encouragement from our discussions with the inspectors was a difficult one to address, assess or qualify. Another issue difficult to capture via review of the HIPEQ was the level of water cleanliness, palatability and worker acceptability. Anecdotally, there are some complaints about hygiene. Such complaints have not been confirmed by our data but rarely does the inspector see the exact conditions present at the time of the incident. The conditions can change significantly even within one day of the incident.

**Shade and Rest Breaks.** Shade was available during breaks in 78% of the outdoor investigations but was present during some work tasks only 49% of the time. While the standard doesn't require shade during work, the lack of work shade does potentially require a greater need for more shade during breaks and potentially the need for more breaks than customarily taken by employees. When asked if breaks could be taken as needed, interviewed employees in 77% of the investigations stated “yes”, but a follow-up question asking if such breaks were generally taken even if needed, the answer was often “no”. Anecdotally, some explanations for not taking breaks include: umbrella too small, desire to finish work and go home early, pay by piece work (only 11% of our cases paid by piece rate), fear of being told to go home and therefore lose pay, the belief that the work is almost done so just keep working and finish it.

**Acclimatization.** The issue of acclimatization continues to require greater employer attention given its association with the development of HRI. The Heat Illness Prevention Standard only requires that the “importance of acclimatization” be covered during training. This occurred in only 21% of the investigations. A protocol for acclimatization, encouraged by some participants in the standard setting process but never adopted into §3395, was only present in 6% of the investigations. From review with the inspectors, this is another confusing concept (training vs. protocol) for inspectors and employers alike.

**Injury and Illness Prevention Programs (IIPPs) and Heat Illness Prevention Programs (HIPPs).** Uniformly, employers have written IIPPs (94%) but few have written HIPPs (36%). Even when a written heat illness prevention program was present, universal coverage of the required elements of §3395 did not occur 92% of the time.

**Training.** Supervisor training was found to be inadequate, especially in cases where an outdoor fatality occurred. In these cases, only 43% of the supervisors had received training on heat illness prevention. In outdoor non-fatality cases, 65% of the supervisors had received training. On a positive note, training was reportedly conducted in an appropriate language for the workforce of the employer.

Our project did not gather comprehensive information about training content (other than with acclimatization), but an area identified in our review as an important area to focus training effort included addressing pre-existing medical conditions and personal risk factors (which were present in approximately 44% of the cases), which may predispose a worker to HRI. These include conditions and risk factors that render a worker more vulnerable to the development of or impact from heat stress but that an employer cannot control and often has no knowledge about. The following examples from the data gathered from our investigations illustrate the types of predisposing information we are referencing: age, obesity, poor physical condition, antecedent viral infection with diarrhea, prescribed medications, current or historic recreational drug abuse, hypertension, cardiac disease, diabetes mellitus, thyroid disease, liver disease and alcohol abuse. The employer’s responsibility in dealing with these conditions and risk factors is to train the workers to recognize their importance and role in the etiology of HRI and to recommend discussion with their personal doctors to determine if any precautions are recommended to minimize the potential impact. Additional guidance to employers on how best to address this important aspect of HRI may be necessary.

**Emergency Response Plans.** The results of our data suggest that overall employers do not have a well defined plan for dealing with heat illness or other medical emergencies.

A small fraction of employers have a written emergency response plan (12%). The universal response from inspectors was that employers policy is “call 9-1-1” when there is an emergency. When called to the worksite, ambulances generally were able to arrive within 20 minutes (25% within 5 minutes), but 25% arrived after 20 minutes. Time is critical when dealing with heat stress victims, especially if heat stroke is developing or has developed, considering that *even with* prompt medical attention, up to 15% of heat stroke victims die.

**Symptom Reporting.** §3395 requires employers to train workers on the importance of reporting heat-related symptoms early. Our data indicate in Table 4 that the presence of reported symptoms is helpful, but the lack of reported symptoms doesn’t help establish if preventive steps could have been taken earlier to mitigate the effects of heat stress and prevent progression of HRI. Unfortunately, symptoms such as muscle cramps, weakness and nausea are non-specific and without effective training will likely be misinterpreted by workers and employers alike as unrelated to heat stress exposure. We therefore continue to see the development of late symptoms in our investigated cases however not to the extent reported in 2005. Loss of consciousness, seizures and disorientation are more ominous symptoms and signs, and when coupled with a high body temperature, are suggestive of heat stroke. If workers wait until these symptoms are present, reversing the damage from heat stroke is difficult and requires immediate medical attention. It is therefore critical that workers are trained to report symptoms *early* even if it means erring on the side of false association.

### **The Serious Nature of Heat-Related Illness**

The 2006 fatalities and the hospitalized victims continue to remind us of the devastating damage caused by HRI. The hospitalized victims that live must survive an aggressive assault on their organ systems depicted by the data shown in Table 5. Lab values were available for many of the heat stress victims, especially those hospitalized or critically ill prior to death. These values demonstrate significant damage to the kidneys, muscles, liver, blood clotting system, acid-base equilibrium and stress to the heart and immune systems.

### **RECOMMENDATIONS:**

- 1. Employers and employees need to continue to recognize the importance of excessive thermal exposure and the devastating illness that can result from HRI.**
- 2. Water needs to be made available and palatable and adequate consumption “encouraged”. The work tasks need to be structured around this need to**

- encourage the consumption of fluids. This may require some creativity as each workplace has its unique culture and workflow.**
- 3. Rest breaks and access to shade also need to be strongly encouraged as a preventive strategy for avoiding HRI. Five minutes is inadequate time to recover from serious heat illness once it has already occurred. The differentiation between the need for preventive breaks and recovery breaks (once HRI has developed) cannot be over-emphasized.**
  - 4. The development of *written* Heat Illness Prevention Programs and Emergency Response Plans needs to improve and address the training elements specified in §3395. Protocols for acclimatization, while not required by §3395, should be strongly encouraged. Such protocols should specify how the work will be designed to allow the worker's body to gradually adapt to the work and environmental conditions and how it will be modified during a heat wave.**
  - 5. Supervisors need to be trained. Employees need the supervision of a management team that recognizes the importance of preventing HRI and enforces protective measures.**
  - 6. Training efforts should be closely timed with heat waves. Some training elements need to be specifically amplified and reiterated. These include the potential interaction between pre-existing medical conditions and HRI, the importance of acclimatization at the start of new work and also during heat waves, and improved supervisor training. Supervisors and workers need to report or observe symptoms early to lessen the potential impact on the body, trigger early medical attention if needed, and therefore, lessen the need for aggressive medical treatment and or the risk of death.**
  - 7. There should be an ongoing effort to produce appropriate training materials that not only cover the elements required by 3395 but to also provide specific information about confusing areas like acclimatization protocol, effective emergency response and heat illness prevention programs, personal medical conditions and risk factors, how best to encourage or quantify fluid consumption.**
  - 8. All efforts aimed at improving heat stress protection in the workplace needs to acknowledge barriers to adequate protection related to language and other cultural issues. Efforts should continue to identify how best to target interventions to ensure adequate protection for groups affected by these barriers.**

**Disclaimers:** This report is based on the information collected and reviewed as described. We are reporting on available data from 38 heat-related investigations and 46 illnesses, but when specific data was unknown or not available on a case, the data could not be included in the final analysis. Therefore, the numbers reported in our tables and referenced in our text do not always add up to a consistent number.

Our presented findings reflect only the information gathered in conjunction with Cal/OSHA enforcement activity following reports of accidents or complaints. Therefore, it does not comprehensively describe the spectrum of HRI in California (CA) workers. This report supplements our memo from 2006<sup>1</sup> and the Heat Illness Case Study Slides presented by Amalia Neidhardt to the Standards Board on June 21, 2007<sup>2</sup>. There are minor discrepancies in the information presented in the slide show due to further analysis and display of the data.

Other important resources are available, which provide a broader picture of HRI in CA. Cal/OSHA has gathered valuable information during 2006 that is not included or addressed in our report. The collected information includes data from over 300 heat-related job inspections conducted by Cal/OSHA during its effort to assess employer compliance with the Heat Illness Prevention Standard<sup>3</sup>. This information is likely to produce a broader picture of the overall impact of T8 CCR §3395. Another important report addressing HRI in CA includes the “Review of July 2006 Heat Wave Related Fatalities in California” by Dr. Roger Trent, which was completed in June 2007<sup>4</sup>. It should be noted that Dr. Trent’s report focused on all observed fatalities (not just those involving workers) during the 2006 heat wave. He observed that most fatalities resulted from classic (or non-exertional) heat stroke; whereas, our data suggests that California workers more commonly developed exertional heat-related illness.

**REFERENCES:**

<sup>1</sup>Prudhomme J and Neidhardt A. Cal/OSHA Investigations of Heat Related Illnesses; February 17, 2006. (<http://www.dir.ca.gov/oshsb/heatillness0.html>)

<sup>2</sup>Neidhardt A. 2006 Heat Illness Case Study. Presented to the Occupational Safety and Health Standards Board; June 21, 2007.

<sup>3</sup>Furillo A. Heat Deaths Drop as State Enforces Job Rules. The Sacramento Bee; September 24, 2007. (<http://www.sacbee.com/111/v-print/story/395333.html>)

<sup>4</sup>Trent R. Review of July 2006 Heat Wave Related Fatalities in California. California Department of Health Services; June 2007.

## HEAT ILLNESS DATA: Outdoor Cases (indoor cases where noted)

DOSH Investigations: April-August, 2006

Table 1: Frequency of Key Descriptive Data (includes indoor cases unless noted)

	Frequency	Percent
<b>Language:</b>		
English	26	57
Spanish	19	41
Other	1	2
<b>Race:</b>		
Black	1	2
Hispanic	20	44
White	24	52
Other	1	2
<b>Gender:</b>		
Male	39	85
Female	7	15
<b>Victim Outcome:</b>		
Death, immediate	5	11
Emergency Room visit only	19	41
Hospitalization > 24 hours	19	41
Hospitalization and Death	3	7
<b>Describe service sector:</b>		
Agriculture	11	29
Construction	8	21
Manufacturing	6	16
Service	4	10
Transportation	3	8
Landscape	3	8
Retail	2	5
Forestry	1	3
<b>Describe work conditions:</b>		
Indoor	9	20
Indoor and Outdoor	9	20
Outdoor	28	60



<b>Describe the nature of work (outdoor cases):</b>		
Light	10	27
Moderate	7	19
Strenuous	20	54
<b>Work Start Time (outdoor cases):</b>		
6:00 am or earlier	14	44
6:01-8:00 am	13	41
8:01-11:00 am	3	9
2:00-5:00 pm	2	6
<b>When ambulance was called to the site, what was the ambulance response time in minutes? (n=24)</b>		
5 min or less	6	25
6-10 minutes	7	29
11-20 minutes	5	21
20-45 minutes	6	25
<b>Days Worked Under Present Environmental Conditions (Days on job or into heat wave 2006) prior to incident (outdoor cases):</b>		
First day on the job	5	15
1-4 days	10	30
5 -7 days	9	27
8-14 days	3	9
> 14 days	6	18
<b>How was the victim transported from the site? (outdoor)</b>		
Ambulance	24	70
Employer vehicle	2	6
helicopter	1	3
Private vehicle	6	18
other	1	3
<b>If Shade was provided, describe type (outdoor):</b>		

building	6	24
Indoors	3	12
tree	5	19
vehicle	6	23
umbrella	3	12
Tarp	1	4
other	2	8
<b>Day of Week Incident Occurred (outdoor cases):</b>		
Sunday	5	14
Monday	9	24
Tuesday	7	19
Wednesday	5	14
Thursday	5	14
Friday	3	8
Saturday	3	8

**Table 2: Key Descriptive Values for Victim and Outdoor Case Environmental Conditions\***

	Mean	Median	Minimum	Maximum
Age (yrs)	41	39	16	79
Victim's Core Body Temp (°F)	102	100	97	110
Heart Rate (bpm=beats per minute)	117	110	55	199
Ambient Temperature* (°F)	100	103	80	116
Relative Humidity* (%)	25	23	2	50
Wind Speed* (mph)	6	6	0	15

\*Environmental conditions for outdoor cases only

**Table 3: Key Covered Elements of §3395: Outdoor Cases (data includes important non-required elements)**

Key Elements Covered	n (%)	n (%)
	Yes	No
Potable Water	29 (88)	4 (12)
Accessible Water	29 (88)	4 (12)
Shade during Work	16 (49)	17(51)
Any Shade during Breaks	25 (78)	7 (22)
Rest as Needed	24 (77)	7 (23)
IIPP	31 (94)	2 (6)
Heat Illness Prevention Program	12 (36)	21 (64)
All Elements of 3395 covered	2 (8)	21 (92)

Acclimatization Protocol	2 (6)	31 (94)
Training on Acclimatization	7 (21)	26 (79)
Emergency Response Plan	4 (12)	29 (88)
Medical Support of Inadequate Fluid	35 (95)	2 (5)
Medical Evidence Pre-existing conditions or pre-disposing HRI risk factors	20 (44)	25 (56)
Paid by piece rate	4 (12)	29 (88)
Supervisor Training—outdoor fatality cases	3 (43)	4 (57)
Supervisor Training—outdoor non fatality cases	17 (65)	9 (35)

**Table 4: Frequency of Reported or Observed Signs and/or Symptoms Experienced by Victims**

Frequency of Symptoms	Percentage with finding	n = Yes	n = No or Unknown
Headache	15	7	39
Muscle Cramps	22	10	36
<b>Weakness</b>	<b>41</b>	19	27
Unusual Fatigue	20	9	37
Unusual Behavior	20	9	37
<b>Nausea or Vomiting</b>	<b>33</b>	15	31
Hot Dry Skin	17	8	38
<b>Fainting</b>	<b>48</b>	22	24
Seizures	9	4	42
<b>Loss of Consciousness</b>	<b>35</b>	16	30

**Table 5: Abnormal Medical Values (n varies per test as reflected in denominator for each test; n= number with specific lab or parameter measured in hospital)**

**2006**

Medical Data/Lab Data (organ or system affected)	Number (%) Abnormal	Mean of Values	Normal Values
Heart Rate (heart)	26/38 (68) <b>HIGH</b>	117 bpm (55-199)	<100 bpm
Potassium (kidney/electrolytes)	16/32 (50) <b>HIGH/LOW</b>	3.7 (3.0-6.7)	3.6-5.1
Sodium (electrolytes)	12/30 (40) <b>HIGH/LOW</b>	136 (127-148)	136-145
CPK (muscles)	17/24 (71) <b>HIGH</b>	2059 (40-20,000)	61-224
Platelets (blood)	13/28 (46) <b>LOW</b>	170K (12-349K)	140-440K
WBC count (stress/inflammation)	10/29 (34) <b>HIGH</b>	8.2 (8.0-19.6)	3.8-10.6
AST (liver)	19/22 (86) <b>HIGH</b>	789 (18-8195)	15-41
ALT (liver)	11/21 (57) <b>HIGH</b>	526 (13-2888)	17-63
Tox Screen (drugs)	3/10 (30) <b>POSITIVE</b>		NEGATIVE

Creatinine ( <b>kidney</b> )	18/31 (58) <b>HIGH</b>	1.8 (1.0-5.0)	0.9-1.3
Blood Urea Nitrogen-BUN ( <b>kidney</b> )	15/30 (50) <b>HIGH</b>	21 (4-61)	7-18
Blood pH ( <b>acidosis</b> )	3/5 (60) <b>LOW</b>	7.3 (6.9-7.4)	7.35-7.45
Brain Edema (9) 1/8	1/9 (11%) <b>PRESENT</b>		Absent