A Critical Review of OSHA Heat Enforcement Cases

Lessons Learned

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Objectives: The aim of the study was to review the Occupational Safety and Health Administration's (OSHA) 2012 to 2013 heat enforcement cases, using identified essential elements of heat illness prevention to evaluate employers' programs and make recommendations to better protect workers from heat illness. **Methods:** (1) Identify essential elements of heat illness prevention; (2) develop data collection tool; and (3) analyze OSHA 2012 to 2013 heat enforcement cases. **Results:** OSHA's database contains 84 heat enforcement cases in 2012 to 2013. Employer heat illness prevention programs were lacking in essential elements such as providing water and shade; adjusting the work/rest proportion to allow for workload and effective temperature; and acclimatizing and training workers. **Conclusions:** In this set of investigations, most employers failed to implement common elements of illness prevention programs. Over 80% clearly did not rely on national standard approaches to heat illness prevention.

The knowledge that workers in hot workplaces are at risk of heat stress, heat illness, and possible death from heat stroke is not new. Military medicine since the Roman Empire has long supported battle readiness through appropriate guidance on managing heat illness.[1] Scientists have made important contributions to the understanding of heat illness and addressed methods to assess the environmental contribution to heat stress.[2–6] State governments have acted to prevent heat illness; for example, California and Washington have regulatory requirements addressing occupational heat stress.[7–8] The Occupational Safety and Health Administration (OSHA) does not have a specific heat-related regulation, but uses section 5(a)(1) of the OSH Act for enforcement action in heat illness cases.[9]

Death is a well-documented consequence of workplace exposure to heat. The National Institute for Occupational Safety and Health reported 423 heat-related deaths among outdoor workers from 1992 to 2006.[10] Table 1 shows the Bureau of Labor Statistics' Census of Fatal Occupational Injuries data on worker heat deaths in 2004 to 2014.[11]

Heat deaths are infrequent and dramatic events, but heat illness occurs frequently. In North Carolina in 2008 to 2010, work-related heat illnesses were the most common cause for work-related emergency department visits among persons aged 19 to 45 years.[12] In Maricopa County, Arizona, in 2002 to 2009, outdoor work in construction and agriculture accounted for 35% of heat-related deaths in men.[13] In the United States during 1992 to 2006, 68 workers died of heat stroke in crop production. The annual average fatality rate of 0.39 heat deaths per 100,000 crop workers was almost 20 times the rate of heat-related deaths in all US civilian workers.[14] Particularly in agriculture, the number of heat illness cases is likely underestimated because some surveys exclude workers on small farms.[15]

After the California Division of Occupational Safety and Health (CalOSHA) established a Heat Illness Prevention Program, OSHA modified and expanded CalOSHA materials in 2011 to initiate a Campaign to Prevent Heat Illness in Outdoor Workers (OSHA Heat Campaign).[16] In 2014, in preparation for the fourth year of the OSHA Heat Campaign, Federal OSHA convened a workgroup to evaluate the effectiveness of existing heat illness prevention materials and tools and to identify needed changes (Workgroup members: Sheila Arbury, MPH, Office of Occupational Medicine and Nursing, Occupational Safety and Health Administration [OSHA]; Brenda Jacklitsch, MS, Education and Information Division, National Institute for Occupational Safety and Health, CDC; Opeyemi Farquah, Office of Science and Technology Assessment, OSHA; Michael Hodgson, MD, Office of Occupational Medicine and Nursing, OSHA; Glenn Lamson, MS, Salt Lake Technical Center, Directorate of Technical Support and Emergency Management, OSHA; Heather Martin, MSPH, Office of Science and Technology Assessment, OSHA; Audrey Profitt, MPH, Office of Health Enforcement, OSHA). To do this, the workgroup planned a review of OSHA heat enforcement cases to determine the adequacy of employer heat illness prevention programs in order to guide outreach efforts. In addition, the workgroup intended to compare OSHA heat illness prevention materials to those of other organizations and update OSHA's resources as needed.

METHODS

Population

OSHA's Information System provided the list of Federal OSHA heat enforcement cases in 2012 to 2013. This list does not include cases investigated by the 27 states and territories that maintain their own occupational safety and health program. It also does not include heat cases investigated by Federal OSHA that did not result in an enforcement action.

Workgroup

Before reviewing the OSHA heat enforcement cases, the workgroup reviewed OSHA's internal and external web pages, the heat stress literature, and OSHA Heat Campaign materials to identify gaps and discrepancies between national standards, recommendations, and existing OSHA guidance. Examples of national standards include the American Conference of Governmental Industrial Hygienists' Threshold Limit Values and Biological Exposure Indices, Heat Stress and Strain chapter,[17] and the US Army Medical Department Heat Illness Prevention materials.[18] National agencies and organizations with heat illness prevention recommendations include the National Weather Service, Office of Climate, Water and Weather Services, and the Wilderness Medical Society.

The workgroup produced a list of the program components required for an effective heat illness prevention program. This list

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TABLE 1. BLS Census of Fatal Occupational Injuries, Heat Deaths, 2004 to 2014

Calendar year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Heat-related fatalities	18	47	44	32	27	35	40	60	30	34	18*

*Preliminary data.

reflected, in part, the content of annual internal OSHA enforcement memoranda on heat-related outdoor inspections issued at the beginning of each heat season. The workgroup created a data collection instrument based on these program components, adding heat event variables (Table 2).

They circulated the draft instrument to additional OSHA and outside experts for review and then used the instrument in a pilot project to analyze 20 cases from the heat enforcement case list for 2012 to 2013. After refining the instrument toward the end of the pilot project, the group undertook a review of the complete case series.

The report on the 20 cases of the pilot project noted that over two-thirds of the deaths occurred on the first to third day on the job, and identified lack of acclimatization in employers' heat illness prevention program as a major risk for heat fatalities in the workplace.[19] This report extends that work to include all 2012 to 2013 heat enforcement cases in OSHA's Information System. The goal was to examine the cases systematically, evaluate employer heat illness prevention programs and their relationship to case outcomes, and recommend actions that employers should take to protect workers from heat-related illness and death.

Data Collection Process

Workgroup members assembled the necessary information from three sources. OSHA's Directorate of Enforcement Programs provided case memoranda, reports, and supporting documents. Telephone conversations with the OSHA compliance safety and health officers who had inspected the worksites supplied additional information available only in their notes. This information included details of the workplace conditions, any heat-related illnesses or deaths that occurred, affected worker characteristics, and description of each employer's heat illness prevention program. Finally, the closest weather station for each case identified conditions on the dates of heat illness incidents, including temperature, heat index, and issued heat advisories. This weather information was compared with the National Weather Service Heat Index chart which displays warning indicators from Caution to Extreme Danger for a range of heat indices.[20]

Statistical Analysis

Data were entered into an Excel spreadsheet, and analyses were developed both in Excel and in SPSS [SPSS 19.0]. Employer heat illness prevention program components characterized as effective and necessary were identified as indicator variables and coded as present (''1'') or absent (''0''). These individual items were then summed into an overall score which provided a semiquantitative indicator of employer heat illness prevention program completeness. Statistical approaches relied on standard parametric and nonparametric tests.

RESULTS

In 2012 to 2013, Federal OSHA made enforcement decisions in 84 heat cases. Twenty-three cases included a worker death (27%)

TABLE 2. Heat Illness Prevention Program Components and Heat Event Variables

Environmental heat sources on day of incident or complaint	Temperature	Heat index	Distance of weather station, if used, from worksite	Heat wave, heat advisory	Direct sun	Lack of shelter	Cloud cover	Local heat sources: machinery, materials, clothing	
Exposure data	Workplace indoor or outdoor	Worker(s) with symptoms of heat illness	Worker(s) to Emergency Department	Worker core temperature if available	Hospital medical records	Diagnosis	Autopsy report		
Worker characteristics	Age	Weight	Medical conditions	Medications	Alcohol/drugs	Days on the job	Acclimatization	Level of work as defined by ACGIH	
Employer heat illness prevention program	Establish formal program with designated, knowledgeable person to implement and manage it	Monitor workplace temperature (heat index and wet bulb globe temperature)	Provide water and encourage frequent water intake	Acclimatize workers by gradually increasing duration and intensity of work	Use work/rest cycles as defined by ACGIH[1]	Train workers on signs and symptoms of heat illness	Monitor workers for signs of heat stress	Plan for emergency response in case of heat illness	

ACGIH, American Conference of Governmental Industrial Hygienists.

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and in 19 cases (23%) one or more workers showed signs of heat illness. Thirty-seven of the workplaces were outdoors and 47 were indoors. Outdoor industries included solid waste collection, mail delivery, oil field servicing, ship repair, asphalt paving, park service, roofing, pipe laying, landscaping, and construction. Indoor workplaces included manufacturing facilities, laundries, restaurants, foundries, and dry cleaners.

Average employer heat program scores did not differ by OSHA region, case enforcement action type, or health outcome (death, illness, no illness). Only one employer had established a worker heat acclimatization program. The other 83 cases not only lacked acclimatization but often other essential components of heat illness prevention programs. Less than half (42%) of the 84 employers had even a few heat illness prevention elements and most did not have a coherent program. Overall, 23% of employers either did not provide water or limited employee access to it, whereas 36% did not make available appropriate heat-shielded rest areas. Although, in general, employers offered regular rest periods, 97% did not adjust the work/rest proportion to allow for current heat conditions and intensity of workload. Only 16% used the daily heat index to identify workplace heat illness risk. Training of workers in heat illness prevention only took place in 25 (30%) of these workplaces and was incomplete in several. Training is especially significant because both indoor and outdoor workplaces frequently include temporary workers who may not receive heat illness training, even if this is made available to permanent workers (Fig. 1).

The authors explored the 23 death cases in detail because they illustrated the worst possible outcome of hot workplaces. Seventeen of 23 deaths (74%) occurred within the worker's first 3 days on the job with eight (35%) on the very first day of work. Documentation of preexisting medical conditions, measures of heat exposure, and physical demands of the workload varied among the cases. Nine of the decedents' postevent medical records did not include a body core temperature—key evidence of heat stroke if greater than 104°F. In six of those cases, no autopsy was available to document the cause of death. Individuals with chronic health conditions such as heart disease, obesity, and diabetes are more susceptible to the effects of heat, and six of the decedents had a history of heart disease and/or hypertension. In five of the deaths, medical examiners attributed the cause to a cardiac event without consideration of the effects of heat as a triggering or contributing factor.

DISCUSSION

In each of the 84 cases, OSHA concluded that the employer heat illness prevention program lacked one or more core components. As in the 20-case pilot study, the most striking program deficit was the absence of an acclimatization program to gradually raise workers' heat tolerance by increasing duration and intensity of work over 1 to 2 weeks.[19] Only one employer addressed acclimatization—an aluminum casting facility with a robust heat illness prevention program. Despite outreach efforts by the National Oceanic and Atmospheric Administration, employers generally did not use the heat index, a simplified metric analogous to wet-bulb global temperature, to trigger or manage heat illness prevention. Even with the availability of OSHA's smart phone heat app, the vast majority of employers did not develop a system to track temperature and relative humidity and to add up to 15° to the heat index for work in full sun.[20] It appears that development of technological tools to simplify heat program management has not yet persuaded employers to implement or modify programs. Strikingly, indoor workplaces in general had higher employer heat illness prevention program scores than outdoor workplaces. This may reflect the use of air conditioning and a decreased effect of external weather conditions in indoor facilities.

Seventeen of the 84 cases' 23 deaths (74%) occurred in the worker's first three days on the job with eight deaths (35%) on the first day of work. Two California studies have similar findings. In a 2005 study of 25 heat illness cases, CalOSHA found that 46% of the heat illness occurred in the first day on the job and 80% in the first 4 days.[21] Over half (54%) of those cases resulted in death. Another CalOSHA study of 38 heat-related investigations in 2006 showed that 82% of that year's heat illness cases occurred during a period of potentially incomplete acclimatization.[22] These data echo the data from the US Army review of heat deaths documenting lack of acclimatization as a major risk factor for death[23–26] and illustrate the critical necessity of employers establishing an acclimatization schedule for workers in a hot workplace. The two CalOSHA studies also revealed that most employer heat illness prevention programs lacked other crucial elements such as a written program and employee and supervisor training.

Recent studies have shown that heat poses a risk factor for death among workers with chronic health conditions such as cardiac disease,[27–29] diabetes,[30] and renal disease.[31–32] Recent data suggest

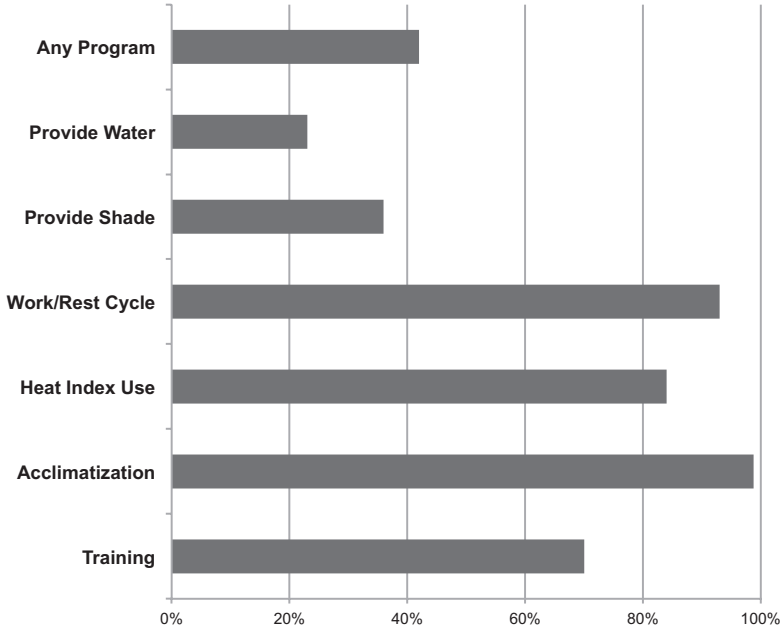

FIGURE 1. Employer heat illness prevention programs: percentage of missing components in 84 cases.

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that heat illness, through dehydration, actually causes chronic renal failure.[33–34] In the five heat cases where death was attributed to cardiac causes, a formal analysis by an occupational physician could have determined that heat, in combination with cardiac risk factors, was the cause of death. Additional documentation of body core temperature and autopsy results, or a more detailed review of the literature, could have supported heat as the cause of death. Collaboration with medical examiners at the state level might lead to greater recognition of heat as a contributing cause to deaths of workers with chronic medical conditions. Lack of acclimatization, however, can be fatal to any worker, young and healthy or with a chronic medical condition; for this reason, an employer-provided acclimatization program is of critical importance.

CONCLUSIONS

This review of 84 OSHA heat cases revealed the general inadequacy of employer heat illness prevention programs. None of the employers in these cases had a program with all the components presented in Table 2. There was little evidence that employers were monitoring weather conditions closely enough to make workplace adjustments to protect their workers. Recommendations to address this failing include: attention to National Weather Service heat watches and advisories; purchase and use of a wet-bulb globe thermometer to monitor temperature; and recognition that full sun adds 15 degrees to the heat index. (Wet-bulb globe temperature is the measure of heat stress in direct sunlight that takes into account temperature, humidity, wind speed, sun angle, and cloud cover. This differs from the heat index that takes into account temperature and humidity and is calculated for shady areas. Additional information is available at http://www.srh.noaa.gov/tsa/?n=wbgt.)

The fact that 17 of the 23 fatalities occurred in the worker's first 3 days of work with eight deaths on the first day illustrates the importance of worker acclimatization. As a result of these findings, OSHA has posted information on acclimatization in a prominent location on its Heat Campaign webpages.[16]

In addition to an acclimatization program, employers could make adjustments to a hot environment which include: shifting workday hours to start work in early morning and end work by early afternoon; assuring an available supply of water and encouraging workers to drink frequently; providing cool areas for rest periods; taking the workload into account to adjust the work/rest cycle to meet heat and workload demands; training workers on the signs and symptoms of heat illness; monitoring workers for signs of heat stress; and establishing and training workers in emergency planning and response.

Hot workplaces can lead to worker illness and death. Section 5(a)(1) of the OSH Act requires employers to provide a workplace that is free from recognized hazards.[9] In light of this responsibility, employers have the responsibility to create effective and complete heat illness prevention programs to protect their workers from heat illness and heat stroke.

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