

**Heat-related Occupational Illnesses in California
Agriculture: Prevention and Regulatory Effectiveness**

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Executive Summary

The annual output of labor-intensive agricultural commodities in California – fruits, vegetables and nursery products – has continued to increase substantially in recent years. Labor demand has also increased as well, although improvements in labor productivity have kept the rate of growth of labor demand lower than the corresponding increase of fruit and vegetable output.

The California farm labor force is mostly comprised of young, Mexican-born, married men with low educational attainment. But a rapidly increasing share of the workforce, as much as 29% overall, are indigenous migrants from southern Mexico who typically have even lower educational attainment and, for many, speak Spanish as a second language.

It is well established that agricultural work is dangerous. The Agriculture, Forestry and Fishing Industry Sector had the highest reported occupational fatality rate of any major industry sector during 2007. A recently published summary of occupational heat illness fatalities among crop workers in the United States finds the largest number occurred in California.

Moreover, thousands of California farmworkers annually experience non-fatal occupational injuries or illnesses that result in lost work time. Accurate data is not available because there is significant under-reporting of occupational injuries and illnesses among farm laborers.

Occupational heat illness cases among the state's farm laborers occur at a rate three times higher than in all industries combined. And Cal-OSHA's own records of heat-related accident investigations during the period 1990-2008 demonstrate that an absolute majority of fatal cases (58%) occurred in agriculture.

In response to an increase in reported fatal occupational heat illness cases, the state of California, in 2005, promulgated the first-ever workplace regulations designed to prevent heat illness. The regulations were initially issued on an emergency basis and then finalized in the following year, and govern outdoor work settings, such as those found in agriculture.

Review of all 504 cases opened during the period 2005-08 in which citations were initially issued to farm employers for violations of the heat illness standard indicates that Cal-OSHA field investigators were vigorous in seeking compliance, especially in 2007 and 2008. The number of inspections among farm employers was substantially increased, and the number of cases in which citations for violation of the heat illness standard rose dramatically.

On the other hand, in the 225 such cases that had been officially closed by mid-April 2009, final penalty assessments were only 57% of the initial penalty amounts. Additionally, in 29% of closed cases in which initial "Serious" citations had been issued, those citations were later reduced to the relatively minor category "Other" and the corresponding penalties substantially reduced.

Conversely, there was not one instance in which an initial penalty amount was subsequently raised nor an "Other" citation raised to the level of "Serious", "Willful" or "Repeat".

There is an unacceptably long delay in reaching the conclusion of open cases that are contested by the employer. Fewer than half of all cases in which a citation was issued to a farm employer during 2006 for a heat illness violation, and which the employer appealed, had been finally closed by mid-April 2009.

There is an association between accidents in farm workplaces and violations of the heat illness standard that requires additional attention. Of the entire total of 492 accident inspections conducted among farm employers during the three-year period 2006-08, fully one-ninth (11%) found violations of the heat illness standard.

One of the most disturbing findings of this review of Cal-OSHA enforcement was that accident inspections in which a heat illness violation was found were more than twice as likely to be associated with an initial "Serious" or "Willful" citation as compared all other types of inspections – complaint, planned, or program related - involving heat illness citations. While this finding does not demonstrate a causal relationship, it does suggest that even more vigorous enforcement may well contribute to a reduction of such accidents.

There are two additional observations regarding Cal-OSHA enforcement. First, in its review of heat-related accident investigations, the agency has failed to issue a clear and transparent statement of its criteria for classifying a case as "heat-related." Thus, disagreement and misunderstandings will persist when parties may have different views of the cause of a particular injury or illness.

Second, there has been no attention given to the possible role of excessive strenuous physical activity in agricultural workplaces. Many agricultural job tasks involve heavy manual labor. Among the very few studies that examined farm workplace practices in California there are findings of a nearly five-fold increase in occupational injury among female farm laborers if they are paid piece-rate as compared with workers paid on an hourly rate basis. Other studies have demonstrated that California farm laborers paid piece-rate work faster than workers paid on an hourly rate basis, and that some workers paid piece rate complained of being overly hot or tired, even to the extent of leaving work early and losing some income as a result.

Background

Agriculture in California

California leads all states in agricultural production. In its latest statistical bulletin, the Department of Food and Agriculture declared:

“...California agriculture saw a 15 percent gain in the sales value of its products in 2007...(and) remained the No. 1 state in farm cash receipts...the state’s 75,000 farms and ranches received a record \$36.6 billion for their output in 2007...The previous (record) high was reached in 2005 when sales totaled \$32.4 billion.”

-California Agricultural Resource Directory 2008-2009, p. 17

Less well known is that, despite droughts and urbanization, the Golden State’s share of total U.S. farm output has steadily increased for more than sixty years.

The single most important factor in the success of California’s farm sector has been the continual increase of its fruit, vegetable and nursery crop production. With a unique combination of mild climate, abundant sunshine, excellent soils, irrigation infrastructure, and access to a virtually unlimited labor supply, for nearly forty years the state has experienced an unparalleled increase in the annual output of these commodities.

Within the state, there are six agricultural regions encompassing all 58 counties, and each region is characterized by a distinct microclimate. The San Joaquin and Sacramento Valley regions experience very hot, dry summers and cool winters. The three Coastal regions (North Coast, Central Coast, South Coast) have somewhat cooler and more humid summers, and periods of heavy rains. The arid Desert region is extremely hot and dry in summer months, followed by warm, dry winters. Farm operators have learned to adapt to the distinctive characteristics of these six regions to produce crops as diverse as lettuce and strawberries on an almost year-round basis, producing from desert region’s fields in the winter months, and from coastal or Central Valley fields during the spring, summer and fall months.

Consumer demand and extraordinary innovations in packaging have been a major factor in the increase of fruit and vegetable production. For example, bagged fresh salad products did not exist twenty-five years ago. Today, this sector of the produce industry reports multi-billion dollar annual sales, and California is the state where this product was developed and then successfully marketed throughout the nation. Less visible is the considerable expansion of exports of high-quality California fruit and vegetable crops to all parts of the world, including such unlikely destinations as Mexico.

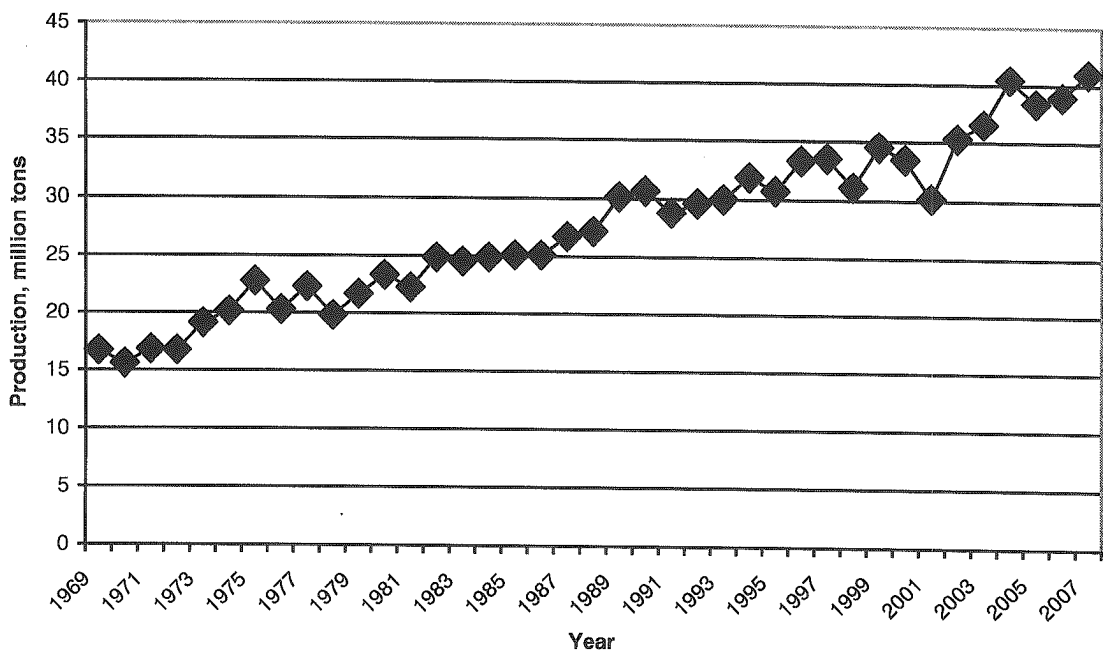
Increased fruit and vegetable production is associated with expanded plantings of these crops. Total orchard land (trees and vines) in the state was reportedly 2.8 million acres in 2007 (United States USDA, 2009a), a 64% increase over the 1974 total (United States Census Bureau, 1977a). Harvested vegetable acres totaled 1.2 million acres in 2007, a slightly more modest 58% increase from the acreage in 1974.

Farm output, as reflected in farm cash receipts from the sale of agricultural commodities, or by acreage figures, are measures of production that have somewhat limited use. Prices receive by farmers are notoriously volatile so that farm cash receipts may actually decline when production increases. Acreage figures may not reflect the

large variations in crop yield that are influenced by weather conditions, pest infestations, and changes in cultivation practices or crop varieties. Notably, farmers may even decide not to harvest a ripe crop if market prices are especially unfavorable. For these reasons, an independent measure of crop output using a physical measure – tons of harvested commodities – is especially useful for interpreting agricultural trends.

Figure 1 shows the annual total of California’s harvested fruit and vegetable crops, measured in million tons. Clearly, the overall trend is a remarkably steady increase in output. The 2007 total of harvested fruits and vegetables was 41 million tons, another new state record (California DFA, 2009). What is especially interesting about the findings presented in Figure 1 is that periods of lower output are invariably followed by sharp upswings, suggesting that the state’s agriculture is remarkably resilient, both in response to periods of adverse national economic conditions (2001-03 recession) as well as from severe climactic stress (1987-1992 drought, December 1998 freeze, and January 2007 freeze).

**Figure 1 - Total Fruit & Vegetable Production (tons), Annual, 1969-2007
California, Source: USDA NASS-CDFA CASS**



In contrast with the long-term increase of fruit and vegetable production, there has been a significant decline in plantings of barley, dry beans, cotton and sugar beets (California DFA, 2009). This trend reflects a pronounced shift by many farm operators away from relatively low-value extensive crops to higher-value intensive crops, such as fruits and vegetables. However, wheat, corn and rice acreage have not declined.

Farm labor demand in California

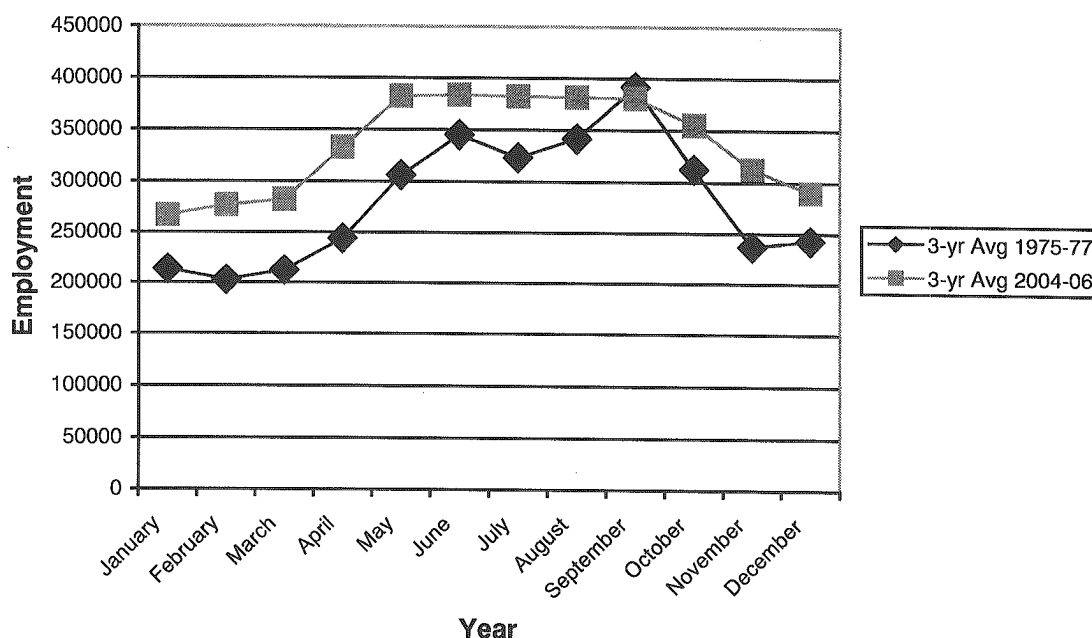
Agricultural labor demand in California has also increased during the past forty years. Prof. Juan Vicente Palerm (Chair, Department of Anthropology, UC-Santa Barbara) has characterized this as the “re-laborization” of California agriculture. However, owing to rising worker productivity and greater reliance on mechanization, labor demand has grown at a slower pace than fruit and vegetable output.

Measuring labor demand in agriculture is complex because many jobs are short-term, lasting only a few months, or even just a few weeks. For this reason, long-term trends are measured using the annual average of monthly employment, and 3-year averages are used to take account of possibly large variations in farm employment owing to difficulties associated with weather, pest infestations or similar irregular events.

Overall, labor demand in California agriculture has increased by about 19% during the past three decades. Specifically, the annual average of monthly farm labor employment during the 3-year period 2004-06 was 335,732 (United States QCEW, 2004-06). This was 19% greater than the corresponding figure of 281,173 during 1975-77 (California State ERS, 1975-77).

An additional trend in farm employment is the increase of longer-term employment and reduced monthly variability. Figure 2 shows the reported average monthly employment figures for both 1975-77 and 2004-06. The prominent employment peak during September during 1975-77 has been replaced by a five-month-long period of peak employment during 2004-06. And in all but one month, employment during 2004-06 was greater than in 1975-77.

**Figure 2. Farm Labor Employment, Monthly, California
1975-77 vs. 2004-06**



There is evidence that more farm laborers are working for longer durations of time in California than was the case in recent decades. Agricultural census reports for the past three decades indicate that the number of regular or year-round farm laborers has

increased by 40%. In 1974, there were 136,216 workers directly hired by California farm operators for 150 days or more. In 2007, the corresponding total was 191,438 laborers (United States USDA NASS, 2009b).

The increased demand for farm labor in the state has contributed to a substantial increase in the state's share of all U.S. crop workers. The National Agricultural Workers Survey (NAWS) of the U.S. Department of Labor finds that over one-third (36%) of all U.S. crop farm workers were employed in California during 2003-04 (Aguirre, 2005), up sharply from the one-quarter (24%) share found by the NAWS in 1989-90.

At the same time, farm operators have increasingly filled short-term labor requirements through labor market intermediaries instead of direct-hire employment. Farm labor contractors, farm management companies and custom-hire businesses now supply the majority of workers needed for temporary or seasonal jobs.

Thus, the present day pattern of farm employment is that regular and year-round workers are mostly hired directly by farm operators but short-term jobs are primarily filled by contract labor. Table I presents findings from the 2008 Quarterly Survey of Agricultural Employment (United States USDA NASS, 2008). This survey, conducted by USDA, provides the only systematic national reports of farm employment.

Most notable in Table I is that farm operators hire an average of four times as many laborers on a regular or year-round basis as compared with the number of workers they hire for shorter-term jobs. Likewise, agricultural service providers also furnish nearly four times as many workers for those jobs as do farm operators.

Table I. Farm Employment, Quarterly Reports, California, 2008

<i>Survey period</i>	<i>Direct-hire, 150 days or more</i>	<i>Direct-hire, Less than 150 days</i>	<i>Agricultural service employment</i>
January 6-12	114,000	18,000	96,000
April 6-12	135,000	21,000	110,000
July 6-12	127,000	33,000	113,000
October 12-18	139,000	34,000	132,000

The rapid increase of farm labor contractor employment in California in the past two decades has been discussed elsewhere (California EDD, 1992; Villarejo & Runsten, 1993). Of special importance in the context of heat-related occupational injury or illness is that responsibility for employment conditions is with the labor contractor, not the farm operator, when such a firm provides workers. Thus, in general, farm operators are insulated from liability when workers on their farms are contracted laborers.

Characteristics of California's farm laborers

According to the NAWS survey of 2,344 crop farm workers in California during 2003-04, this labor force is comprised mostly of young, low-income, married, Mexican men (Aguirre, 2005). Almost all crop laborers said they were Hispanic and 95% were foreign-born, nearly entirely of Mexican origin.

The NAWS finds the median number of years of hired farm work in California was 11, but nearly one-fifth (18%) said they had been in the state for less than two years.

The large proportion of newcomers reflects the relatively high rate of worker turnover among farm laborers.

Nearly half (49%) of crop workers interviewed were unaccompanied by any member of their nuclear family while working in California. Among men, the proportion was even greater: nearly two-thirds (60%) were alone. For these workers, sending remittances to family members in their home country ranks among their highest priorities.

California's crop farm laborers have limited formal education: median educational attainment is just six years of school. Many crop workers (43%) said they could not read their native language "well" and over one-fifth (21%) said they could read only "a little" or none at all.

The single most important recent trend among the state's farm laborers is the substantial increase of the number of indigenous migrants from southern Mexico. Many of the new migrants prefer to speak their own language. In the context of discussions of literacy, it should be noted that most Mexican indigenous languages do not have a written form. Thus, the non-literate proportion among indigenous Mexican migrants is higher than in the work force as a whole.

Additionally, there is evidence that educational attainment among indigenous Mexican migrants is substantially less than among other Mexican-origin migrant workers. According to an authoritative early study, median educational attainment of Mixtec migrant workers was just two years of formal education (Zabin et al, 2003).

The NAWS estimates that indigenous migrants comprised about 16% - 20% of the state's crop farm labor force in 2003-04, and that this share is continuing to increase rapidly over time. For example, among those who entered the California farm labor force in the two-year period preceding 2003-04, the NAWS finds that about 38% were indigenous migrants. A knowledgeable key informant, presently conducting a comprehensive survey of indigenous migrant farm laborers in California, indicated the statewide proportion was about 29% in 2008.

Occupational Injury and Illness in California Agriculture

Agricultural occupations are consistently ranked among the nation's most dangerous. In 2007, the Agriculture, Forestry and Fishing (AFF) industry sector had the highest annual rate of occupational fatalities of all industry sectors: 27.9 fatalities per 100,000 full-time equivalent workers (U.S. DoL BLS, 2009). Agricultural employment is estimated to account for 94% to 96% of the AFF labor force (National Research Council, 2008).

Information regarding fatal occupational injuries in California agriculture is available for 2005, but not yet reported for any subsequent year. In a preliminary summary, the Division of Labor Statistics and Research (DLSR) of the California Department of Industrial Relations reported there were 44 agricultural occupational fatalities during 2005 (California DIR, 2005). Using the annual average employment figure for 2004-06 discussed in the previous section, this translates into an incidence rate of about 12 occupational fatalities per 100,000 full-time equivalent workers.¹

Occupational injury rates in California agriculture are not accurately known, in part because under-reporting is believed to be widespread. A knowledgeable key informant reports that examination of records of the state's Workers Compensation Insurance File (WCIS) for agricultural workers during the period 2000-2007 revealed only half of the case files included both the Employer's Report of Occupational Injury or Illness (Form 5020) and the Doctor's First Report of Occupational Injury or Illness (Form 5021). Submissions of both forms are required under California law.

Published data for 2007 by DLSR indicate an annual incidence rate of 4,100 non-fatal occupational injuries and illnesses per 100,000 full-time equivalent workers among farm laborers in the state (California DIR, 2007). An earlier comprehensive review of the ten-year record (1990-1999) of paid claims under workers compensation to hired farm workers in California indicated a significantly higher incidence rate of 10,546 occupational injuries and illnesses per 100,000 full-time equivalent agricultural workers (Villarejo, 1998).

Part of the apparent discrepancy between the two incidence rates quoted above is that paid claims under workers compensation include both first aid claims as well as all non-indemnity claims. Some of these types of cases are likely under-reported in the DLSR survey.

Cross-sectional surveys conducted among California farm laborers yield findings of incidence rates for occupational injury within the range indicated above. A 1997 survey reported an incidence rate of 9,300 occupational injuries per 100,000 workers among Hispanic migrant farm laborers (McCurdy et al, 2003). A statewide cross-sectional survey of hired farm workers conducted during 1999 found an incidence rate for men of about 6,000 occupational injuries per 100,000 full-time equivalent employees (Villarejo & McCurdy, 2008).

Musculoskeletal disorders are the most prevalent types of occupational injury occurring among the state's farm laborers. The NAWS in 2003-04 finds nearly one-

¹ Self-employed workers (farmers and ranchers) are included in the data on occupational fatalities. In California, this number is estimated to be 30,000 full-time-equivalent workers. Thus, annual average farm employment is the sum of hired workers plus self-employed workers, or about 363,000.

fourth of California's crop workers (24%) reported experiencing at least one musculoskeletal problem (Aguirre, 2005). Moreover, the NAWS survey also finds the prevalence of this type of occupational injury to have increased significantly from rates found during the previous four-year period: the prevalence was 20% in 2001-02, and just 18% in 1999-2000.

The 1999 statewide cross-sectional survey finds, among women farm laborers, the prevalence of persistent pain in multiple body parts is associated with an increased number of years of farm labor (Villarejo & McCurdy, 2008). In other words, the longer the duration of exposure to heavy manual labor, in this case measured by the number of years performing this kind of work, the greater is the likelihood of sustaining a musculoskeletal injury. This finding is statistically significant (Spearman r 0.24, $p < 0.01$).

Importantly, there is compelling evidence that the likelihood of occupational injuries among hired farm workers is significantly elevated if earnings are determined on a piece-rate basis. The 1997 occupational health survey among Hispanic migrant farm workers finds that female workers were more than four times likely (O.R. 4.9; 95% C.I. 1.8 – 12.8) to sustain a workplace injury when paid by piece-rate as compared with those who were paid on a fixed hourly rate (McCurdy et al, 2003).

There are only a very few field-based studies in California agriculture of the association of the pace of farm work with the manner of employee compensation: hourly wages vs. incentive pay, such as pure piece-rate wage or hourly wage plus piece-rate earnings. In vineyard pruning work, conducted in the winter dormant season, workers in the same vineyard who were paid on a piece-rate basis, on average, worked 37% faster than those who were paid an hourly rate (Billikopf Encina, 1988).

Heat-related illness

The term “heat illness” is not a recognized clinical condition. The World Health Organization’s International Classification of Diseases and Related Health Problems, known as ICD-10 in its 10th Revision, indexes ten adverse health outcomes associated with elevated environmental heat conditions (United Nations, 2007). The most commonly recognized, in approximate ascending order of severity, are as follows.

- Heat rash
- Heat syncope (heat collapse, fainting)
- Heat cramps
- Heat exhaustion due to water depletion (heat prostration)
- Heat exhaustion due to salt (and water) depletion (heat prostration)
- Heat stroke

In the present paper, the generic term “heat illness” will be used to refer to occupational injury or illness cases in which any one of the internationally recognized adverse health outcomes has been diagnosed by a qualified medical authority. The term “heat-related illness” will be used to refer to the possibly complex circumstances in which worker exposure to elevated environmental heat conditions was a likely contributing factor to an adverse health outcome, if not the principal cause.

Of the adverse heat illness conditions listed above, the most severe is heat stroke. This condition is life threatening and is clinically characterized by excessively high core body temperature (>40 degrees Celsius - 104 degrees F) accompanied by hot, dry skin, and central nervous system abnormalities, such as delirium, convulsions or coma (Bouchama, 2002). The time frame from presenting mild symptoms to life threatening may be very short.

Heat stroke can be the result of exposure to excessive environmental temperature/humidity conditions, or from excessive strenuous exertion. These two types are described as classic, or nonexertional, heat stroke, and exertional heat stroke.

Individual susceptibility to heat illness varies considerably, and is difficult to predict in a specific person. However, research conducted during “heat waves” finds the following risk factors associated with a greater prevalence of such illnesses: age (infants and the elderly), lack of access to adequate cooling (such as provided by air conditioning), social isolation, pre-existing medical conditions, impaired mobility, low socio-economic status, and sub-standard housing conditions.

The risk factors for the occurrence of heat-related illnesses among workers include elevated temperature/humidity (heat index), strenuous exertion in uninterrupted direct sunlight, lack of individual acclimatization, dehydration, excessive strenuous exertion, and wearing unsuitable, impermeable clothing in such conditions. While any one of these factors is significant, exposure to all of these risks at the same time is particularly unhealthful.

Mitigation strategies to prevent heat-related occupational injuries and illnesses that are believed to be effective include training of supervisors and foremen, worker education, periodic and sufficient hydration (both before and during work), reducing the level of exertion, acclimatization, and prompt access to first aid and/or emergency

services. Both effective prevention measures and educating those at risk are required to control occupational heat stress (Lim, 1994).

Prevention of heat-related injury or illness by promptly reducing the level of exertion when warranted is a widely utilized mitigation strategy of the U.S. military services. This mitigation intervention is less likely to be implemented by an employer in a workplace setting, especially when “time is of the essence” to complete a job task.

Prevention of heat stroke requires acclimatization to heat, reducing the level of strenuous exertion, drinking additional water, consumption of salty foods, and increasing the amount of time spent in an air-conditioned environment (Bouchama, 2002). Among football players, significant reductions of the level of physical activity, and avoidance of dehydration and salt depletion have proven to reduce the occurrence of heat stroke (Knochel, 1975).

Heat-related Occupational Injuries & Illnesses in California Agriculture

Analysis of national data on heat-related occupational fatalities among crop workers in the U.S. finds that California had the largest number of reported fatal cases (n=20) during the period 1992-2006 (U.S. CDC MMWR, 2008). North Carolina ranked second in the number of cases (n=13), but had the highest imputed incidence rate.

Recently, a study based on review of individual records in the California WCIS file of occupational injury and illness identified 271 farmworker cases as likely heat-related during the eight-year period 2000-2007 (Harrison, 2009). The imputed average annual incidence rate of occupational heat illness among California's farm laborers was estimated to be 16.2 cases per 100,000 full-time equivalent workers. When analyzed according to major industry sector, the annual average incidence rate in California agriculture was about three times larger than for all California industry sectors combined (11.1 cases vs. 3.8 cases, both in reference to 100,000 full-time-equivalent workers in the sectors, respectively). As previously discussed, there is likely to be significant under-reporting of agricultural occupational injuries and illnesses in the WCIS file.

That farm laborers are significantly under-represented in government records of occupational injury and illness was independently found to be the case in the state of Washington where the prevalence of heat illness has been studied using workers compensation records (Bonauto et al, 2007; Fan et al, 2006). These studies indicate there are both individual as well as industry components associated with systematic underreporting.

Cal-OSHA released a summary report of its investigations of twenty-five occupational heat illness cases in all industry sectors that had occurred during 2005 (California OSHA, 2006). Half of the cases had a fatal outcome. Nine of the twenty-five cases were in agriculture.

Among the findings reported are that in 80% of all cases the affected employee had been on the job for fewer than four days, and for nearly half of all cases the incident occurred during the employee's first day of work. Both findings suggest it is likely that workers were poorly acclimated to workplace conditions.

Fainting or loss of consciousness was seen in nearly 80% of the cases, and in over 20% of the cases the worker presented seizure activity. In many of the cases, the affected worker had obvious, easy to observe symptoms suggestive of heat related illness, but the presence of these symptoms was not reported to the employer.

This Cal-OSHA summary report includes the significant observation that, "Exertion and workload also played a key role in producing heat-related illness in cases where temperature appeared less threatening." But there was no mention of how exertion or workload was assessed, including whether worker earnings were based on hourly rate or piece rate compensation.

The authors mention they had not yet completed a statistical analysis of the investigations. At this writing, no such analysis has been forthcoming from the agency.

Cal-OSHA also released a summary of its heat-related accident investigations for the period 1/1/1990 – 7/22/2008 (California OSHA, 2008). The specific industries represented with the corresponding number of workers affected are as follows: construction (n=37), agriculture (n=50), wildland firefighting (n=7; not an industry,

actually an occupation), manufacturing (n=7) and services (2). A total of 40 workers were reported as having died in these incidents, of which 23 were farm laborers.

Finally, a study of piece rate compensation among California farm laborers unexpectedly turned up an association with exposure to heat illness risk. In interviews with 448 farm laborers who had been paid piece rate wages while working in various crops (cherries, grapes, melons, peaches and tomatoes), 11% reported they had chosen to leave work early, either from time to time, or regularly. Two key motives mentioned as reasons for leaving the job early were (1) getting overly hot or tired, or (2) insufficient earnings based on the piece rate (Billikopf, 1995).

Cal-OSHA General Industry Safety Order (8 CCR 3395)

In response to an unexpected cluster of cases of heat-related occupational fatalities during 2005, the Governor directed Cal-OSHA to promulgate emergency regulations designed to prevent worker injuries or illnesses in outdoor settings. The emergency regulations took effect August 22, 2005, and were made final after agency review and public comment during 2006.

The so-called "heat illness standard" is intended to reduce risks to health that arise from workplace exposures known to be associated with occupational heat-related illnesses. The main requirements of this standard pertain to provision of adequate water to prevent dehydration, provision of shade during periods of preventive rest, training of all supervisory and non-supervisory employees regarding mitigation of heat illness risk factors, establishment of procedures for the prompt response to medical emergencies, and written descriptions of above procedures to be made available to all employees.

These regulations are quite specific, for example, requiring that 2 gallons of drinking water be made available for each employee per eight-hour shift. Also, that rest in a shaded location shall be made available for a minimum of 5 minutes at any time for any worker who requests a "shade break."

More recently, Cal-OSHA has promulgated official guidelines for the heat illness standard. During March 2009, for the first time, a temperature trigger was announced that, if exceeded, would require the employer to provide a shade structure for 25% of persons working outdoors. According to the new guidelines, if, at 5 pm of a given day, the predicted high temperature at the outdoor work site for the following day is expected to exceed 85 degrees F, then the shade structure would be required to be in place at the worksite.

The permissible distance of the shade structure from workers is also specified, as is the requirement that it be of sufficient size to accommodate 25% of those persons working outdoors at a given time. Moreover, if the predicted temperature is expected to be in excess of 85 degrees F, the shade structure must be present at the beginning of each shift and present throughout the workday.

However, a little noticed caveat is that, regardless of the predicted temperature, if the measured temperature at the work site exceeds 90 degrees F, then shade must be present. Thus, if the predicted temperature is, say, 84 degrees F, then the employer would not be required to make a shade structure available unless the actual temperature at the work site exceeds 90 degrees F.

Cal-OSHA Enforcement of the Heat Illness Standard

Under terms of agreement with the U.S. Occupational Safety and Health (OSHA), the State of California assumed responsibility for enforcement of Federal occupational safety and health regulations within the state. Cal-OSHA is responsible for both Federal OSHA regulations as well as stricter California OSHA Standards.

An important difference with respect to enforcement in agriculture is while the Federal agency is prohibited from enforcement on farms with fewer than 10 workers, Cal-OSHA has jurisdiction over all farms in the state regardless of the number of employees. This distinction is quite important because three-fourths (75%) of California's 29,661 farms with directly hired workers have nine employees or less (United States NASS, 2009).

Cal-OSHA conducts inspections on farms as well as more thorough investigations of specific incidents, such as those involving a workplace fatality or injuries to multiple workers that resulted in hospitalizations. Reportedly, Cal-OSHA field staff members have recently sought to investigate every identifiable case of a workplace heat-related injury or illness incident, even to the extent of contacting hospitals, clinics and first-responders in an effort to determine whether a specific occupational injury or illness might be heat-related.

All key informants interviewed in preparing the present report commended the efforts of Cal-OSHA field staff with respect to their efforts regarding enforcement of the heat illness standard in agriculture. Some even said that Cal-OSHA had been exceptionally vigorous in those efforts.

In order to assess the outcomes of Cal-OSHA field enforcement of the heat illness standard in California agriculture, the entire set of individual case reports for the period July 25, 2005 through December 31, 2008 were reviewed in detail. These case reports are available to the general public via the website: www.osha.gov.

A note of caution is in order before discussing the findings of this review of Cal-OSHA enforcement activities. Many cases studied in this review were not yet closed and were still under review by the agency's staff, or in a lengthy appeal process. Once a case is opened, any citation may be reviewed by Cal-OSHA regional supervisors or contested by the employer.

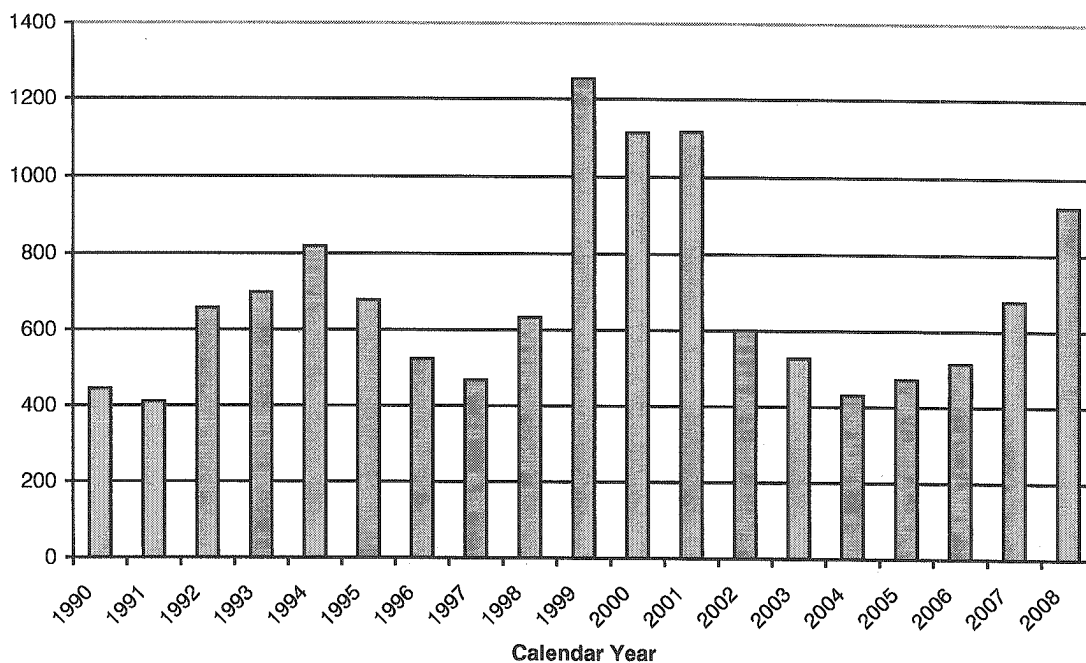
Appeals by employers who have been cited for alleged violations of occupational safety and health standards may be referred to an administrative law judge, or may be brought to the state's three-member Occupational Safety and Health Appeals Board. The latter Board meets every two weeks to adjudicate cases. Appeals denied by the Board may even be brought to the court system for further review. Appeals, as described further below, are often finally decided as much as three years after the original citation was issued. But only when a case is officially "closed" is it possible to arrive at a firm conclusion regarding the outcome, such as whether an initial citation remains in effect. As is repeatedly presented in descriptors accompanying open cases on the website itself:

"The following inspection has not been indicated as closed. Please be aware that the information shown may change, e.g., violations may be added or deleted."

It is of the greatest importance that “closed” cases be considered separately from those that remain open. At the same time, the numbers and types of cases opened during the above-cited period is fixed, will not change over time, and can inform some conclusions regarding Cal-OSHA’s efforts.

First, we find that Cal-OSHA opened a substantially greater number of cases involving farm employers during the two calendar years 2007 & 2008 – 1,602 cases in all – than was the case in any two-year period subsequent to 2001. On the other hand, the total number of cases opened among farm employers in 2007 & 2008 was still substantially smaller than the corresponding total in 1999 & 2000, when 2,367 cases were opened. The findings regarding cases opened by year from 1990 through 2008 are presented in Figure 3 below.

**Figure 3. Cal-OHSA Inspections in Agriculture
Number of Cases Opened, by Year, 1990-2008**



Not all opened cases correspond to inspections having been conducted. Especially in agriculture, where farm operator and labor contractor business turnover is relatively large, some firms may have gone out of business, moved or otherwise can’t be located. Thus, the number of field inspections completed in a given year is actually smaller than the number of cases opened.

Taking account of this factor leads to the conclusion that Cal-OSHA inspections completed in agriculture were about 60% greater in 2007-08 as compared with the most recent earlier two-year periods. During successive two-year periods of calendar years 2003-2008, the two-year sub-totals of inspections of farm employers that were actually completed were 892 in 2003-04, 933 in 2005-06, and 1,456 in 2007-08. Clearly, Cal-OSHA significantly ramped up efforts in agriculture during 2007-08.

Second, there were 504 cases opened in which citations were issued to farm employers for violations of the heat illness standard during the period July 25, 2005 through December 31, 2008. These cases can be compared with the total number of inspections among farm employers in each of the years 2005 through 2008. This is shown in Table II where both the number of cases in which any initial citation for violation of the heat illness standard was issued as well as the number in which at least one of the initial citations was either “Serious” or “Willful”.

What is apparent from the findings reported in Table II is that Cal-OSHA not only significantly increased its field enforcement efforts in agriculture during 2007 and 2008, but the agency also issued a far greater number of citations for violations of the heat illness standard as well. In fact, in 2008 more than one-third of all inspections among farm employers resulted in the issuance of a citation for violation of the heat illness standard. Equally significant, fully one-seventh of all agricultural inspections in 2008 resulted in an initial citation for a serious or willful violation of the heat illness standard.

Table II. Farm Employer Inspections Completed: Cases with Citations for Violations of the Heat Illness Standard, and Cases with Initial Serious or Willful Violations of the Heat Illness Standard, Cal-OSHA, 2005-08

Source: Author’s analysis of data from www.osha.gov

<i>Calendar Year Case Opened</i>	<i>Cases with Inspections Completed</i>	<i>Cases with Initial Citations Issued for Violation of T8 3395</i>	<i>Cases with Initial Serious or Willful Violations of T8 3395</i>
2005	447	6 (1%)	2 (0%)
2006	486	58 (12%)	42 (9%)
2007	630	145 (23%)	26 (4%)
2008	826	295 (36%)	114 (14%)

The findings summarized in Figure 3 and Table II will not be affected by whether or not a case has been closed. They simply refer to field activities initiated by Cal-OSHA with respect to farm employers. Moreover, by reference to “Initial” citations in the figures quoted in Table II, the findings are independent of later agency decisions or outcomes resulting from a possible appeal.

Review of all Cal-OSHA inspections of farm employers in which a workplace accident had occurred indicates that about one-ninth of all accident inspections were associated with findings of violations of the heat illness standard. During the three-year period 2006-08, Cal-OSHA accident inspections among farm employers totaled 492 cases. In 52 of these cases (11%), Cal-OSHA inspectors reported an initial violation of the heat illness standard. This analysis is limited to the period 2006-08 because the emergency heat illness standard was decreed in late July 2005, implemented in August 2005, whereas the earliest date on which citation for violation of the standard was issued was December 1, 2005.

As can be inferred from the data presented in Table II, most cases in which initial citations were issued for violation of the heat illness standard were not in the categories “Serious”, “Willful” or “Repeat”. Rather, most cases (321 of 504, or 64%) involved only citations in the relatively minor category “Other”. Multiple citations were relatively

common so the total number of citations initially issued greatly exceeds the number of cases. Just two cases involved initial citations for “Willful” violations and one case involved a “Repeat” citation.

Most cases with initial citations for “Serious” or “Willful” violations of the heat illness standard (50%) were associated only with T8 3395 E, the requirements for training of all employees regarding heat illness, or having a written heat illness safety plan. Cases with initial “Serious” or “Willful” citations that involved only the lack of the required amount of drinking water were much less prevalent (8%), while cases with initial “Serious” or “Willful” violations in which only the provision of shade was inadequate were somewhat more prevalent (29%). In the remaining cases of “Serious” or “Willful” initial citations (13%), there were combinations of the T8 3395 E regarding training or having a written safety plan with either lack of adequate shade or lack of adequate drinking water, or both.

It is of considerable interest to examine how inspections were initiated. Nearly three-fourths of all inspections that resulted in an initial citation for a violation of the heat illness standard were “Planned,” i.e., targeted inspections of a cross-section of farm employers in a given region of the state at a particular time of the year. The findings for all 504 cases in which citations were issued for violations of the heat illness standard are presented in Table III. Importantly, inspections initiated by complaints were far less prevalent than planned inspections.

Table III. Farm Employer Inspections Completed: Cases with Initial Citations for Violations of the Heat Illness Standard, by Inspection Type, Cal-OSHA, 2005-08

Source: Author’s analysis of data from www.osha.gov

<i>Type of Inspection</i>	<i>Cases with Initial Citations Issued for Violation of T8 3395 (percent of all)</i>	<i>Cases with Initial Serious or Willful Violations of T8 3395 (percent of type)</i>	<i>Cases with Only Initial “Other” Violations of T8 3395 (percent of type)</i>
Accident	52 (10%)	29 (56%)	23 (44%)
Complaint	46 (9%)	16 (35%)	30 (65%)
Planned	371 (74%)	129 (35%)	242 (65%)
All other	35 (7%)	10 (29%)	25 (71%)

What is surprising in the findings presented in Table III is that the proportion of accident inspections in which there was an initial citation for violation of the heat illness standard was considerably greater than the corresponding proportion among other types of inspections. In fact, within the range of statistical uncertainty, the proportion of initial citations for serious violations was the same, roughly one-third, among each of the other three inspection categories.

The association between accident inspections and an initial citation for a serious or willful violation was found to be statistically significant ($p=0.003$). In particular, accidents were more than twice as likely to be associated with an initial finding of a serious or willful violation than non-accident inspections (O.R. 2.42; 95% C.I. 1.35 – 4.32).

Cases Closed with Citations for Violations of the Heat Illness Standard

Of the 504 cases opened among farm employers between July 25, 2005, and December 31, 2008, in which at least one initial citation for violation of the heat illness standard was levied, 225 cases had been closed as of April 19, 2009 (the reference date for the present report). Thus, some 279 cases remained open on that date and subject to possible future modification.

There were a substantial number of closed cases of violations of the heat illness standard in which the total of penalties assessed were reduced during the review or appeal process. In 67 of the 225 cases (30%) the amount of penalties assessed were reduced from the initial value.

On the other hand, there was not even one case in which an initial penalty for a violation of the heat illness standard had been subsequently increased. The fact that such a large proportion of penalties were later reduced but none increased suggests OSHA's website claim that penalties may be increased in open cases is somewhat disingenuous.

Overall, in the 225 closed cases in which there was at least one initial citation for violation of the heat illness standard, the aggregate total of final penalties were a grand total of just \$234,709, or 57% of \$412,771 assessed in initial citations. Interestingly, in the 67 closed cases in which initial penalties had been reduced, just 34 cases had been appealed. In other words, in 33 cases of the 67 with penalty reductions (49%), no appeal had been filed. Evidently, Cal-OSHA supervisors had themselves undertaken reductions of penalties.

According to interviews with key informants, Cal-OSHA supervisors may offer a penalty reduction up to 25% if the employer shows "good faith" by promptly correcting the violation. A major goal of Cal-OSHA enforcement activities is termed "abatement", which refers to correcting identified workplace safety risks. Correction of unsafe workplace practices is arguably one of the agency's most important tasks.

Consideration of reduction of penalty amounts is also reportedly allowed for "small" employers, again up to 25% of the initial total, on the grounds that such employers may lack sufficient administrative capacity to give adequate attention to every detail of compliance. The criterion for determining what constitutes a "small" employer is not known, nor is the extent to which this waiver is actually applied.

In the 225 closed cases under consideration herein, 55 cases involved an initial citation for a "Serious" violation of the heat illness standard. But in 16 of those 55 cases (29%), the citation was subsequently reduced from the status of "Serious" to the category "Other," either by Cal-OSHA supervisors or through the appeal process described earlier (the available data indicates most, but not all, instances of citation severity downgrading resulted from an appeal filed by the employer).

In none of the 225 closed cases in which citations were issued for violations of the heat illness standard was a citation for a "Serious" violation added after initial citations were issued, nor were any of the less serious "Other" violations upgraded to the status of "Serious" or "Willful."

Importantly, for all analyses of closed cases discussed hereinafter, in each instance in which the initial citation was "Serious" but was subsequently reduced from that status to the category "Other," the type of violation has been designated as "Other"

Thus, the final classification of the violation category has been used, not the initial category.

In 31 of the 55 closed cases (56%) with an initial citation for a “Serious” violation of the heat illness standard, the total of all penalties assessed had been reduced from their initial amounts. Even among cases in which the initial citation was only for violations termed “Other,” 170 closed cases, the final penalties had been reduced in 36 cases (21%).

For closed cases involving farm employers, the duration between the date on which a violation of the heat illness was issued, and the date on which the case was closed was typically remarkably long. Of all cases with a citation issued in calendar year 2006, fewer than half had been closed by April 19, 2009, the reference date of this report.

Cases in which the employer contested citations were far more likely to be associated with a greater duration between the date of issuance of a citation for a violation of the heat illness standard and the close date. For example, just 11 cases (8%) of the 137 in which a citation was issued in 2008 and then appealed by the employer had closed by April 19, 2009, the reference date of the present report. But 79 cases (51%) of the 154 cases for the same year of issuance (2008) in which the employer had not appealed were closed by that date. Clearly, appeals result in significant delays in the ultimate resolution of cases.

Penalties ultimately assessed are far more likely to be substantially reduced from the amount of the initial penalties when farm employers contest citations. Thus, appeals both lengthen the duration between the issuance of a citation as well as frequently result in a significant penalty reduction.

With respect to closed cases in which a farm employer was cited for violations of the heat illness standard in which the employer pursued an appeal, just 22% of the initial penalty amounts remained after the appeal was concluded (\$42,505 out of initial penalty total of \$191,255). In the closed cases in which the employer did not appeal the citations, some 87% of the initial penalties remained (\$192,204 out of initial penalties totaling \$221,516). As in all analyses of closed cases in the present report, these findings refer just to cases that had been closed as of April 19, 2009.

Association of Accident Cases with Serious Violations of the Heat Illness Standard

One of the most important findings of the present report’s review of Cal-OSHA inspections of farm employers is an association between accident cases and serious violations of the heat illness standard. With reference to closed cases in which a citation for violation of the heat illness standard was ultimately upheld and final penalties assessed, farm employment workplace accident cases were more than three times as likely to be associated with a serious violation than non-accident cases (O.R. 3.85; 95% C.I. 1.36 – 10.86). The finding was statistically significant ($p=0.011$).

This finding, by itself, does not prove that a serious violation of the heat illness standard was the only or primary cause of those accidents. However, it does suggest that a serious violation of the heat illness standard may have been a significant contributing factor. Clearly, a more thorough study of each such case is warranted.

Farm Labor Contractors vs. Farm Operators: Heat Illness Standard Violations

All employer names for the 504 cases of farm employment heat illness citations were compared with records of licensed farm labor contractors, both for 2009 as well as for earlier years. The purpose was to determine whether the employer name matched a name in the license file at the time of the issuance of the citation. Names and mail addresses were then compared between the Cal-OSHA case record and the DLSE file of farm labor contractor licenses to verify the license status of farm employers who were likely to have been licensed labor contractors. Finally, this list was also compared with files of the California Secretary of State to provide independent verification of the employer name and mail address for incorporated businesses or limited liability companies. A total of 227 cases of heat illness citations were found to be attributable to farm labor contractors who held state licenses from the Division of Labor Standards Enforcement (DLSE) of the California Department of Industrial Relations..

All other business names were compared against the author's files of farm operators, packer/shippers and food processing firms. Ultimately, 255 cases were determined to involve businesses of those types.

Finally, 22 farm employers cited for heat illness violations could not be confirmed as a licensed farm labor contractor, farm operator, packer/shipper or food processor. These represent 4% of all case records examined.

Among closed cases, there were 92 cases in which licensed farm labor contractors were cited for violation of the heat illness standard, and 126 cases in which other types of farm employers were cited. Only 7 closed cases involved unclassified farm employers that were cited.

Although there were some small differences in findings regarding closed cases in which farm labor contractors had been cited for violations of the heat illness standard, as compared with all other farm businesses categories that had also been cited, none were statistically significant. Specifically, for closed cases, farm labor contractors were slightly less likely to have been cited for serious or willful violations than were other types of farm employers that had been cited, but the difference was not statistically significant ($p=0.709$). Also, for closed cases, farm labor contractors were somewhat less likely to have been associated with accident inspections in which a citation was issued for violation of the heat illness standard than were other types of cited farm employers, but, again, the difference was not statistically significant ($p=0.407$).

Discussion and Conclusions

Cal-OSHA has clearly substantially increased its enforcement and educational efforts with respect to heat illness prevention, and for this the agency should be commended. Moreover, the assessment of a very large fine, possibly the largest ever imposed by Cal-OSHA, against a labor contractor whose violations of the heat illness standard were initially found to be “Willful” got the attention of employers throughout the state. According to one key informant, shade structures popped up everywhere in the San Joaquin Valley shortly after the amount of the penalty in that case became known.

This same labor contractor’s license was later revoked, and the owner as well as two key supervisors now face criminal manslaughter charges. There is little doubt among workers and employers that there can be very serious consequences for violations of the heat illness standard.

At the same time, Cal-OHSA’s post-inspection review and appeal process are obviously intended to encourage the employer to reduce an identified workplace risk in violation of one or another standard by essentially offering a cash bonus in the form of a reduction of the amount of penalties assessed as well of offering a possibly multi-year delay in determining the final outcome. These penalty reductions and delays send the wrong message to employers.

Notwithstanding the commitment to enforcement and compliance, of great concern is that reports of heat-related illness cases in California agriculture by Cal-OSHA lack clear and transparent statements of the criteria actually used for this classification purpose. In particular, the Cal-OSHA memorandum regarding its accident investigations of 25 such cases during 2005 (California OSHA, 2006), and its 2008 listing of such cases during the period 1990-2008 (California OSHA, 2008) both fail to disclose this essential information.

As a result of this lack of transparency, disagreements have arisen with respect to whether or not several specific fatality cases were, in fact, properly classified as heat illness. The United Farm Workers suggests there were six fatalities during 2008 among farm labors that were likely caused by heat illness, but Cal-OSHA only attributes three of the six to heat illness. One informant suggested that the criteria used by Cal-OSHA regarding classification of cases as heat illness may have changed in recent years.

If there is ambiguity in attributing cause in the fatal cases, each of which have coroner or medical examiner records as well as thorough investigative records readily available, proper classification of non-fatal cases may even be more ambiguous because records may be lacking or incomplete. As one key researcher in the field noted, among agricultural worker records in the state’s WCIS file of workers compensation cases, in half of the heat-related cases, one or the other of the required reports from physicians and employers were missing.

As noted previously, the term “heat illness” is not a recognized clinical condition by the internationally recognized ICD-10 disease classifications. The term “heat-related” is even less precise.

It is apparent from the present review that agricultural workplace settings present two major types of risks of heat-related occupational illnesses or injuries: non-exertional, owing to excessive environmental heat, and exertional, owing to excessive strenuous

activity. Of course, in many settings, both risks may be present simultaneously. After all, many job tasks in agriculture are understood to involve heavy manual labor.

Most of the discussion of preventing heat illness in the agricultural safety literature and in regulations has tended to focus on mitigation of non-exertional risks. There is little or no consideration of rules that would determine if or when exertional risks should be mitigated by stopping work altogether or imposing a mandatory extended rest period for all workers. Nor is there any serious discussion of what constitutes excessive strenuous activity, in contrast to regulations setting a precise temperature trigger for mandatory provision of shade.

None of the literature even discusses measures of exertion in agricultural workplaces. The only crude indicator available is whether a worker is compensated by an hourly wage or by piece-rate. Even these crude measures are absent from any of the published investigations of heat illness cases. And the Employer's Report of Occupational Injury and Illness (Form 5021) does not even include this simple fact about how the worker was paid.

The few reports in the literature concerning piece-rate pay make it abundantly clear there is an elevated risk of workplace injury and that employees tend to work faster under that incentive compensation scheme, sometimes even to the point where some workers have voluntarily chosen to stop work early, forgoing needed income, because they are too hot or tired.

Workers are expected to initiate requests for preventive break time, with a perceived loss of a portion of much-needed income. Moreover, the minimum preventive break time that the employer must furnish is a mere 5 minutes, irrespective of how long the employee has been working or the prevailing environmental heat conditions. Yet, there is no evidence available regarding how many workers have initiated such requests for shade rest, nor the duration of typical shade rest periods actually taken.

Additionally, the workplace culture regarding rest breaks was fundamentally altered in recent years. The regulation that formerly required a mandatory 15-minute break for each 4 hours of work was amended several years ago, making it optional instead, based on the worker's presumed free choice. Is there any record in the heat illness investigative record regarding the affected workers' practices with respect to rest breaks? If such information is in the official records, it should be made public promptly.

The required provision of shade may fail to meet the medically essential criterion of a genuinely cool setting, which is what is required to recover from the possible onset of a heat illness episode. If the ambient temperature in the shade, where official temperature readings are made, is in excess of 100 degrees F, a place that is shaded in such circumstances cannot be described as "cool."

There is even less serious discussion of mandatory acclimatization, despite the finding in Cal-OSHA's own investigations of heat illness accident cases during 2005 that a majority of affected workers were at their first day of work for that employer, and that 80% had been on that job for less than four days.

The rapid increase of the numbers of indigenous migrant farm laborers from southern Mexico, now at least one-fourth of the labor force, raises a number of very important concerns. Many of the new migrants speak Spanish as a second language, if at all. Fourteen indigenous languages are now spoken in California's fields. Is training being provided that assures understanding among the new migrants?

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