Protecting Workers from the Heat: Significant Advancements and Future Implications

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Heat-related illness (HRI) in the workplace has gained increased attention in the occupational and environmental medicine (OEM) research literature in recent years. This research has led to great progress in this area, with the development and implementation of specific recommendations designed to protect workers. The role of the OEM physician will be crucial in driving guidance on work in the heat through hazard recognition, risk mitigation and advocacy. This will become more important in the coming years as the changing climate increases the risk of HRI in the workplace. This essay will describe why the occupational heat-exposure recommendations are the most important advancement in the protection of workers from HRI, the role climate change will play in HRI, and the evolving science around risk factors for HRI.

The Most Important Advancement

The most important step in protecting workers from HRI was the identification of occupational exposure limits. American Conference of Governmental Industrial Hygienists (ACGIH) and National Institute for Occupational Safety and Health (NIOSH) have both published recommendations for occupational heat exposure[1,2]. ACGIH identified Action Limit Values (ALV) and Threshold Limit Values (TLV), which utilize a temperature of 25 Celsius and 28 Celsius for the work environment respectively. The ALV's are inherently more conservative and directed towards an unacclimatized worker, whereas the TLV's are less conservative and directed towards acclimatized workers[1]. NIOSH provides the Recommended Alert Limits (RAL) and Recommended Exposure Limits (REL) which, (similar to the TLV and ALV) are for unacclimatized and acclimatized workers respectively[2]. The exposure limits and the difference for unacclimatized and acclimatized workers were first identified in 1963 by Lind, who studied workers on a treadmill and had the work later validated[3–6].

HRI is confounded by many modifiable and non-modifiable risk factors[7–9]. Therefore, recommendations must balance the diverse occupational environments and personal risk factors of workers. NIOSH and ACGIH exposure limits have tackled this dilemma and provide worker protection across all types of workplace situations by combining environmental and worker metabolic factors into their recommendations[1,2]. The lack of published federal government standards in the United States makes recognizing the importance of putting these guidelines into practice paramount in protecting workers from heat stress.

Exposure limits and worker protection

Workers exposed to heat, without the protection of guidelines, make up a large majority of the work-related fatalities[10]. In 2013 when the Occupational Safety and Health Administration (OSHA) reviewed 20 occupational heat related enforcement cases (including 13 fatalities), all 20 cases had incomplete or absent heat illness prevention guidelines[10]. There were 359 documented cases of occupational heat-related deaths from 2000-2010 in the United States alone[11]. Data from 2018 shows that the exposure limits have "100% sensitivity in identifying fatal levels of heat stress" which suggests that the recommendations from NIOSH and ACGIH are able to protect the majority of workers if implemented[12]. Beyond the fatalities, there is emerging evidence to show that occupational heat stress has also been associated with an increase in traumatic injuries[13]. This provides some valuable insight into the current state of our ability to protect workers from heat stress.

Despite guidelines, there is still a role for the OEM physician in raising awareness and assisting employers in implementing heat stress mitigation strategies[14]. One of the factors that makes the exposure limits significant, is that they include more variables than just the ambient temperature of the environment such as work rate, environment factors, and clothing[2]. However, research shows that there may be some important variables such as recommended work duration may not be captured by the guidelines[15]. OEM physicians, in accordance with the "Environmental Health" and "Hazard Recognition" core competencies, can play an important role in identifying risk factors for heat stress that may not be written directly in the guidelines[14]. Furthermore, advocacy for updated guidelines also follows the American College of

Occupational and Environmental Medicine guidance statement for “Prevention of Occupational Heat-Related Illnesses” of designing programs to prevent HRI in workers[16].

The seasonality of heat exposures has been well documented, with 83% of occupational heat-illness related emergency department visits occurring in the months June, July or August[17]. Heat-related deaths for outdoor workers occur in the summer months, and are expectedly in disproportion to the rest of the year, with data in outdoor labor workers showing 78% of the heat-related deaths occur in the months June, July or August[18]. This means that there are increasing news and media reporting of heat-related deaths during the summer, resulting in increased public concern and advocacy[19]. Yet, in colder seasons, the momentum to rally a push for implementation and development of guidelines for heat related deaths decreases significantly[19]. This role can be filled by an OEM physician who are trained to recognize the risk factors for heat-illness and have the tools and knowledge required to provide guidance to organizations and employers on how to best implement the ACGIH and NIOSH recommendations for heat exposure limits.

The lives saved from the guidelines, and the fact they were able to be implemented despite the seasonality of HRI in workers is a major achievement. There is, however, another challenge on the horizon, one that could call into question the effectiveness of our exposure limits and guidelines in the future.

Changing climate and changing working population

The increasing normalcy of extreme weather patterns puts us at risk of viewing the increased HRI from climate change and our demographic shifts as being unremarkable, which could stunt the growth of new guidelines and lead to more unnecessary deaths from heat in the workplace[20,21].

The international panel on climate change (IPCC) predicts with “high confidence” that climate change is going to lead to “more frequent and more intense hot extremes on land, as well as longer warm spells.”[21] When taking this into account, as well as the data demonstrating that those periods of prolonged heat extremes are when workers are most vulnerable to heat is key to understanding the role climate change will have[22].

An equally important perspective is to view how climate change will affect different socioeconomic groups. Migrant workers are often provided with little occupational health protection[23], and coupled with sparse guideline enforcement is a significant risk factor for HRI. Furthermore, due to the predicted climate changes, outdoor workers who get paid by their productivity are anticipated to have slower work output which can lead to less income[23,24]. Workers with low income have more difficulty accessing home cooling options (e.g., air conditioning), which can increase their risk of mortality during a heat wave if they are not able to cool down between days of work[25].

Evolving the guidance based on emerging science.

The future effects of climate change will also be compounded by the changing demographics of the population. There is significant inter-individual (E.g. age, sex, chronic disease) and intra-individual (E.g. hydration status, sleep) variability in the physiological impact of heat stress [26]. Cardiovascular disease, diabetes, hypertension and other chronic health conditions have been shown to decrease the body's ability to thermoregulate, and increase the risk of HRI [7,8]. Females and older adults have been shown to be at increased risk of occupational heat stress[26]. Statistics Canada shows an increasing trend of workers 65 and over in the labor force[27]. With the prevalence of people in Canada living with multiple chronic health conditions sitting at over 12%, understanding the role chronic health conditions and medical factors play within occupational heat stress is critical.[28] [7]

This means aging workers and those with certain chronic diseases will be working in hotter and more unpredictable environments, with a demonstrated reduced physiological capacity to dissipate heat. The guidelines were not designed with an aging workforce and increasing comorbidity in mind. Therefore, the science of heat stress in older workers with chronic diseases mandates consideration of these factors that may render them vulnerable to occupational heat illness[7]. An emphasis on new guidelines that utilize personal and medical factors that individualize the interventions embedded in an updated form of these guidelines is needed.[29] The OEM physician will be uniquely positioned to consider medical factors in evaluating risk of occupational heat illness for range of industries and occupations.

In a controlled laboratory setting, medical factors, and personal factors (e.g., age, BMI) have been documented to have serious effects on workers' ability to perform work and thermoregulate[9,30]. Furthermore, it has been shown that hypertension, obesity, and cardiovascular disease increase the risk of HRI[7]. Given this evidence, it would be expected that personal and medical factors would be reported in the global literature on documented cases of occupational heat related illness and death. However, a recent review found that only 3.8% of the literature includes participants who live with chronic health conditions[31]. When you consider that nearly half (45%) of people in the United States have at least one chronic health condition, the disparity in the research becomes very clear[32]. Marginalized populations have even higher rates of health conditions, meaning this work is important not just from a public health perspective, but through an equity lens as well[33].

There is a relative paucity of research examining the impact of personal health factors on heat stress in the workplace. Until this research is further evolved it will not be possible to implement personalized heat exposure limits to increase workers' safety. This means that workers who are at increased risk of HRI may not be sufficiently protected by current guidelines[9]. This presents yet another opportunity for the OEM physician to consider medical factors in the worker, heat stress risk assessment and prevention as well as the operational needs of employers all in concert.

Conclusion

To summarize, I believe that the heat exposure limits and the guidelines that sprouted from them have been the biggest advance in protecting workers from HRI. This is due to their role in maintaining a standard of safety in heat exposure year-round and their proven efficacy. The ongoing changes in the world's climate and workforce demographics mean that these guidelines need to evolve with the working populations they were designed to protect. The evidence informed guidelines should protect workers who we know are at higher risk due to the changing climate and improved understanding of personal and medical risk factors for occupational heat-illness. The original research that identified heat exposure limits has shown that we are capable of implementing evolving data into guidelines that will save the lives of workers. This means that it is possible for further research to assist in moving towards implementing the next generation of guidelines. The goal of complete absence of heat related deaths in workers is indeed a daunting one, but it is one of the utmost importance.

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