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The Imperative to Incorporate Climate Change Competencies into Occupational and Environmental Medicine Training to Safeguard Worker Health

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Alya Khan: Conceived the paper. Involved in writing and editing of manuscript and all tables.

Manijeh Berenji: Contributed to Table 2. Involved in writing and editing of manuscript.

Marianne Cloeren: Developed Table 1 and the figure. Involved in writing and editing of manuscript.

Stefan Wheat: Contributed to Table 2. Involved in writing and editing of manuscript.

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Abstract

Objectives: Identify relevant gaps and suggest modifications to OEM Graduate Medical Education to increase knowledge about potential climate change impacts, teach practical skills, and promote relevant actions to protect workers.

Methods: ACOEM competencies were aligned to the Global Consortium on Climate and Health Education (GCCHE) physician competencies. ACGME OEM milestones were re-examined using a milestone curricular guide based on the peer-reviewed GCCHE competencies.

Results: Climate-change related OEM knowledge and skills are proposed for each OEM core competency domain. Nine residency milestones mapped to the ten ACOEM core competencies are highlighted by incorporating a climate-related activity along with a call to action.

Conclusion: OEM training already provides more climate-relevant content than other specialties. Nonetheless, OEM residents need more climate change education to help employers, workers, and their communities to anticipate, mitigate, and adapt to climate change.

Keywords:

Graduate medical education; residency; climate change; training; milestones; competencies

Learning Objectives:

- Develop 2-3 strategies to incorporate climate change health education into occupational and environmental medicine residency curriculum
- Evaluate residents during their residency and at the final evaluation using suggested revised competencies and milestones from this paper that incorporates climate change health education

Introduction

A 45-year-old truck driver here for biennial commercial driver medical exam reports increasing headaches at the end of the workday. The driver explains that the company recently instituted a program to reduce idling time when trucks are waiting to load or unload, to save fuel and truck maintenance costs. However, the truck driver explains that the cab gets very hot without air conditioning, and wait time can be hours with the engine off. Work tasks also include loading and unloading the trucks while outside, from loading docks without shade, and a need to rush to make a tight delivery schedule.

This case illustrates just one of many scenarios in which a climate-related issue, such as heat stress, could arise during a typical occupational and environmental medicine (OEM) evaluation. It illustrates the need for OEM training to include climate-related risks and health effects so that graduates will be better able to recognize, treat and prevent these issues in workers.

Extremes in temperature over extended periods of time, extreme weather events and disasters affect workers' productivity, physical and mental health, and quality of life. As temperatures rise, infectious disease patterns are changing, with once-regional diseases like malaria expanding their range, and once seasonal diseases like Lyme disease becoming perennial.^{1,2} Climate change's escalating effects pose grave challenges for workers. Outdoor workers and workers in non-climate-controlled indoor environments are especially vulnerable to heat stress and other climate-related health threats including air pollution from wildfire smoke. The surge in natural disasters puts first responders, emergency operation workers, and clean-up crews at increased risk for acute toxic and infectious exposures, physical injury and psychological trauma. Workers in many different settings will feel the stress of living through a prolonged climate disaster, leading to increased absenteeism and presenteeism. We are already seeing the health effects of

warming aquatic ecosystems, with increasing waterborne pathogens and harmful algal blooms, affecting those in occupations that interact with freshwater or marine systems.³ Safeguarding worker health and well-being in the face of these changing climatic conditions necessitates proactive, direct engagement of healthcare professionals with employers and workers, to create resilient, sustainable systems for hazard control, emergency response and preparedness.

OEM physicians are in a unique position to understand and manage climate-related worker exposure risks and clinical outcomes, developing and applying multi-pronged adaptation and mitigation strategies. Trained OEM physicians assess worksite and community exposures, using a “hierarchy of controls” paradigm to reduce hazardous exposure risks for worker populations (see Figure 1)⁴ involving redesigning the work environment where possible, implementing engineering and administrative measures, developing medical surveillance programs, and educating workers and their supervisors on the appropriate use of personal protective equipment. Their environmental health expertise includes interpretation of environmental indicators relevant to occupational and non-occupational settings, including air quality and heat indices as well as risks related to chemical contamination in the environment.

Figure 1 NIOSH Hierarchy of Controls with Climate Change Examples⁵

In this article, we discuss the ways OEM training currently addresses climate change risks and health effects, identify relevant gaps and suggest modifications to OEM Graduate Medical Education (GME) to increase knowledge about potential climate change impacts and relevant actions and practical skills to protect workers.

Role of OEM Physicians in Workplace Adaptation to Climate Change

The American College of Occupational and Environmental Medicine (ACOEM) has defined the competent OEM physician as one knowledgeable about climate change and its health effects.^{6,7}

OEM physicians advocate for healthier workplaces and guide evidence-based interventions in worksites and communities. Many OEM physicians work in settings where they develop protocols for mitigating climate and environmental stressors, potentially aiding GME Programs in incorporating climate change education into their curricula.

For example, OEM physicians can train workers and supervisors to prevent and recognize early symptoms of heat-related illnesses, including the use of the Heat Safety Tool (digital app) offered by the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH). This app offers real-time outdoor heat and humidity readings, warning levels, symptom lists, and recommends appropriate first aid measures.⁸ With a strong foundation in population health and workplace management, OEM physicians also have a role in helping employers develop heat stress plans, required in some states now⁹. Given the increase in vector-borne diseases due to changing environmental conditions¹⁰, OEM physicians can provide assessments about local trends in mosquito- and tick-transmitted illnesses, incorporating existing screening tools and directing preventive actions to mitigate disease spread. OEM expertise can also be used to assess and evaluate the occupational and public health impacts of new climate solutions, for example, mining for metals and minerals for renewable energy or of geoengineering solutions.

In the case of our truck driver, preventive measures can be taken to reduce this worker's risk of a heat-related illness. While the employer's anti-idling policy is commendable from an air pollution standpoint, it makes the driver vulnerable to the effects of heat. Exploring other options for the waiting truck driver (such as establishing a designated cooler waiting area near the truck or providing cooling vests or neck wraps) could protect the driver from heat. A comprehensive heat illness prevention program, including planning for heat mitigation, education, acclimatization periods, and "heat alert" protocols for extremely hot days can be implemented for dissemination across all departments and worker units.

Current OEM Training

With the climate crisis upon us, there is a need for increased emphasis on controlling, mitigating and responding to climate-related hazards in OEM education. For example, disaster management, heat illness prevention, and anticipatory guidance to employers and workers in the absence of regulations need more emphasis. OEM training programs must enhance resident training to include identifying climate-associated hazards, conducting climate-specific exposure assessments, and implementing climate-relevant medical surveillance programs.

Current State of Undergraduate and Graduate Medical Education

As educators grapple with the challenges of training a climate-ready and resilient healthcare workforce, the Global Consortium on Climate and Health Education (GCCHE) and other experts^{11,12} have published 'climate change and health' professional education competencies that align with existing ACGME competencies at the UME and GME level. Using these and other

tools like the Planetary Health Report Card,¹³ medical schools are increasingly integrating climate change and other planetary health issues into their curricula.¹⁴ The GME landscape includes case reports of residency programs describing their experiences and approaches to curricular integration of climate change and health issues.¹⁵ A handful of specialty-specific curricular tools and guides have also been described for pediatrics,¹⁶ internal medicine,¹⁷ and psychiatry^{18,19} residency education. More comprehensive GME-specific curricular guidance continues to be developed and piloted by residency faculty around the US²⁰. A small number of fellowship training programs and professional development programs aimed at fostering leadership in climate change and health have simultaneously emerged to support development of faculty expertise in this emerging content area.²¹

Globally, there is limited climate and health training for health professionals. These gaps in climate-related competencies and practice activities, especially in low- and middle-income countries, highlight a critical need to incorporate climate change and health education into healthcare workforce development worldwide²¹.

Previous OEM guidance has outlined responsibilities and general strategies that OEM professionals can incorporate into their practice in assessing climate change impacts on workers and their communities.⁷ More specific guidance and practice recommendations around hazards like heat-related illness have been described.²³ While prior work has highlighted the urgency for OEM physicians to proactively engage in safeguarding workers from climate change,^{6,7} this paper provides specific recommendations and competencies for training aspiring OEM physicians to manage these hazards.

Assessing Competencies and ACGME OEM Milestones

ACOEM's most recent OEM competencies statement describes 10 domains expected of specialists in this field,²⁴ yet it lacks sufficient reference to the detailed knowledge and skills needed to mitigate the effects of climate change on workers. These competencies encompass areas such as clinical occupational and environmental medicine, environmental health, hazard recognition, evaluation, and control, disaster preparedness and emergency management, etc. We aligned ACOEM competencies to the GCCHE core physician competencies, proposing additional language to relate each OEM domain to specific climate change knowledge and skills in Table 1, with the aim to suggest additions to strengthen the current OEM competencies rather than replace what is currently in existence.

We re-examined the ACGME OEM milestones utilizing a milestone curricular guide based on the peer-reviewed GCCHE competencies. This approach allows for the incorporation of climate-related competencies into the assessment of resident physicians' progressive development of knowledge and skills in OEM, while maintaining alignment with established educational standards (Table 2). Nine milestones among the ten ACOEM competencies are highlighted by incorporating a climate-related activity to enhance the resident's understanding of the topic. Each milestone ranking is accompanied by an example of what may be done by the trainee to achieve that milestone ranking. The numbering of Table 2 follows the numbering of the existing ACOEM OEM competencies. This proposed revision empowers clinical competency committees to apply these milestones. The curricular guide serves as a flexible framework rather than a strict directive and offers new insights into the milestones' application and relevance in the evolving GME landscape.

Call to Action

The field of OEM can provide leadership to the healthcare community grappling with the impacts of climate changes. OEM physicians, specifically those affiliated with academic institutions, can reshape GME curricula to address climate change education by (i) developing competency frameworks for climate-related hazards and (ii) creating interprofessional collaborations to activate and deploy climate-specific medical surveillance and resiliency toolkits (resources that can assist healthcare providers, patients, and administrators prepare for climate change and its impacts)²⁵. By training OEM physicians in these areas, they can also engage with emergency rooms, urgent care clinics, federally qualified health centers, and other healthcare facilities in improving patient care and health outcomes. Examples for integration of modular competencies with case studies include:²⁶

- Disaster response and recovery
- Excessive heat
- Air pollution due to wildfire smoke
- Increased risk of:
 - Vector-borne diseases
 - Waterborne infections
 - Zoonotic and other disease outbreaks
 - Harmful algal blooms
 - Psychological impacts (e.g., ecoanxiety)
 - Toxic exposures
 - Food insecurity
 - Allergens

Additional suggestions include rotations that collaborate with corporations, unions, safety professionals, and industrial hygienists on climate change mitigation and preparedness projects. Quality Improvement (QI) projects are an opportunity to address healthcare disparities as they relate to climate change health effects among vulnerable workers. ACGME requires that “residents must receive training and experience in quality improvement processes, including an understanding of health care disparities” (ACGME Common Program Requirements VI.A.1.b).(1).(a)). A common educational tool used in OEM training programs include worksite visits so they can identify and assess workplace hazards in real-time in a variety of industries. These site visits can give residents the opportunity to inspect and visualize the climate hazards specific to each site. This would include a robust analysis of how the climate hazards are directly and indirectly impacting worker health and develop an employer action plan for short-term adaptation as well as long-term mitigation efforts. Training programs can also partner with non-profit organizations and public health departments to collaborate on community-based participatory research projects to foster climate resiliency efforts⁵.

Conclusion

OEM training already provides more climate-relevant content than other residency specialty training⁵. However, more emphasis on climate is needed to prepare our residents to be the recognized leaders in climate change preparation, mitigation and adaptation. This paper highlights the importance of utilizing the GCCHE competencies and ACGME milestones in OEM residencies to recognize and prevent climate change-related health issues. Through the strategic use of technological advancements, increased environmental consciousness, and fostering partnerships among medical institutions, work environments, and local communities,

OEM physicians can effectively prevent climate-related illness and promote wellbeing to ensure a safer and healthier work environment

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Figure Legend

Figure 1 NIOSH Hierarchy of Controls with Climate Change Examples⁵

This figure highlights the National Institute of Occupational Safety and Health (NIOSH) Hierarchy of Controls paradigm to reduce hazardous exposure risks for worker populations. In this figure, each control is paired with a climate change example.

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Figure 1

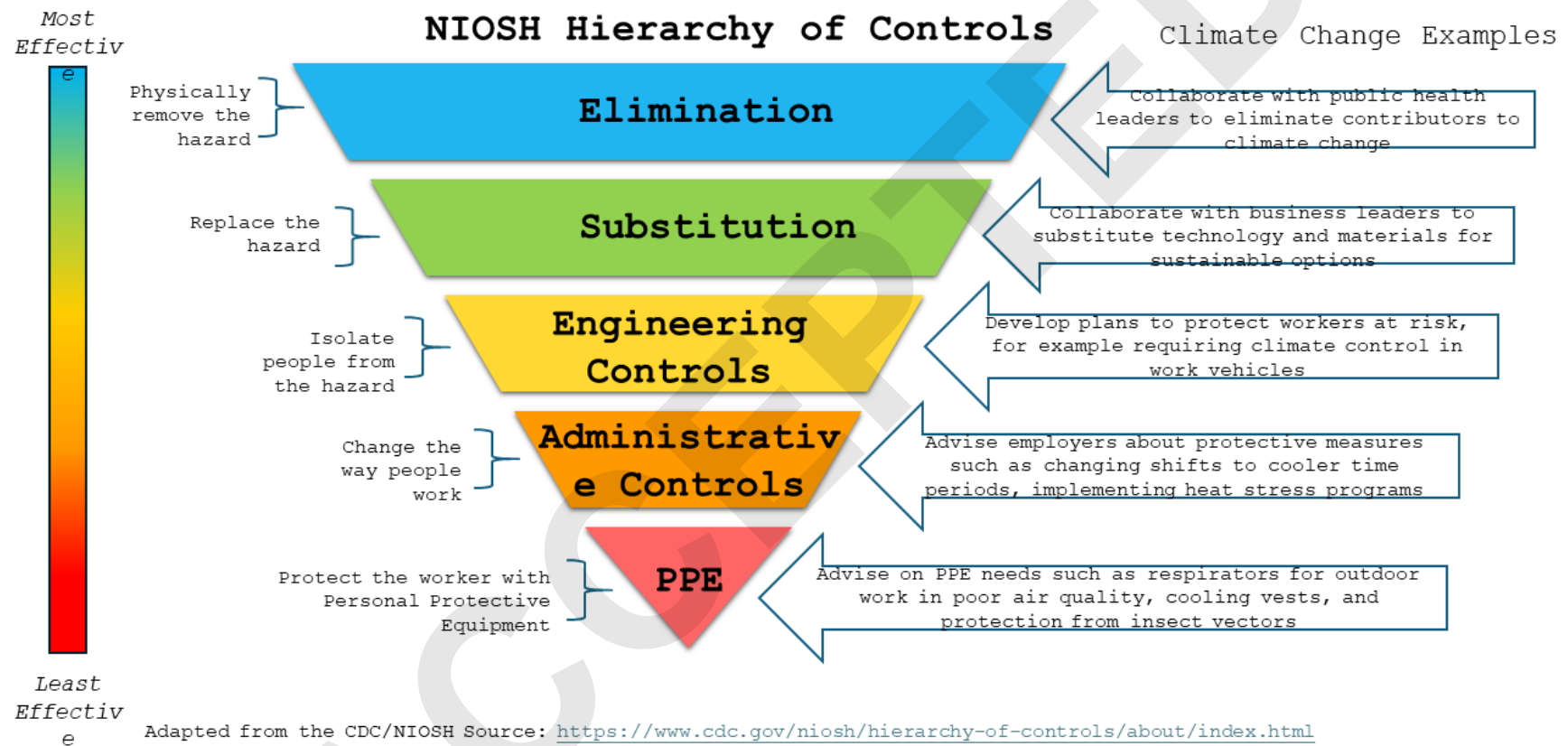


Table 1: Recommended ACOEM Core Competencies²⁴ Additions Mapped to the ACGME and GCCHE Climate Change Core Competencies²⁷.

ACOEM Competency	Recommended Additions	ACGME Core Competencies	GCCHE Competencies
Clinical Occupational and Environmental Medicine	OEM physicians are expected to understand, consider and mitigate the impact of working in extreme conditions, such as outdoors in high temperatures. OEM physicians should also recognize the risk of elevated particulate levels to the cardiovascular and respiratory health of workers in all settings.	Patient Care, Medical Knowledge, Interpersonal and Communication Skills, Professionalism	1.2.1 Climate change has broad and profound impacts on human health.
OEM Related Law and Regulations	Include the Occupational Safety and Health Administration (OSHA).	Practice-Based Learning and Improvement, Interpersonal and Communication Skills, Professionalism and Systems-Based Practice	3.1.0 Subnational, national, and global policy frameworks and governance structures are necessary to address health risks associated with climate change.
Environmental Health	Environmental issues to include the impact of climate change. OEM physicians should recognize that the effects of climate change include increasing temperature, broadening range of vector-borne diseases, air pollution from wildfires and ground and water contamination from flooding. Environmental health competencies will increasingly require attention to psychological distress, food and water insecurity and displaced populations. OEM physicians should lend	Patient Care, Medical Knowledge, Interpersonal and Communication Skills, Professionalism and Systems-Based Practice	1.1.1 Climate change is one of the greatest threats to human health in the 21st century and urgent action is needed to affect its trajectory. 1.1.2 Human health is highly dependent upon planetary health, including a stable climatic system which supports the foundations for all life such as air, water, and food. 1.1.3 Climate change is a result of some natural and mostly human drivers. 1.1.4 Climate change impacts vary by location and geography.

	their expertise to local organizational efforts aimed at mitigation of the effects of climate change and become experts in the health risks of climate change for the worker populations they serve.		1.1.5 Demographics, economic development, technology, and other activities create pressures on the climate and environment. 1.6.1 Global, regional, national, local, and Indigenous environmental data must be utilized to guide health decision making to prevent, prepare for and respond to climate-related events. 2.1.1 Employ effective communication skills with stakeholders about climate and health topics. 4.2.1 Climate change, biodiversity loss and rapid environmental change affect disease emergence, distribution, and prevalence.)
Work Fitness and Disability Management	OEM physicians should consider physical demands and work environment, including working in temperature extremes and under poor air quality conditions.	Patient Care, Medical Knowledge, Interpersonal and Communication Skills, Professionalism	1.2.1 Climate change has broad and profound impacts on human health.
Toxicology	OEM physicians should recognize the impact of chemical releases and the diverse range of contaminants on the ecosystem as a result of climate change and use this knowledge to promote efforts to decrease such pollution.	Patient Care, Medical Knowledge, Practice-Based Learning and Improvement, Professionalism and Systems-Based Practice	1.2.1 Climate change has broad and profound impacts on human health ...Describe major health outcomes associated with climate events, including both direct and indirect impacts, and their mechanisms. Extreme precipitation/sea level rise resulting in flooding – risks to Water, Sanitation and Hygiene (WASH) infrastructure/healthcare infrastructure, forced migration, mental health, trauma, drowning, vector-borne diseases, mold

			illness, drinking water contamination, gastrointestinal diseases, skin and eye diseases and infections, malnutrition.
Hazard Recognition, Evaluation, and Control	OEM physicians should apply these principles to the range of hazards associated with the changing climate.	Medical Knowledge, Practice-Based Learning and Improvement, Interpersonal and Communication Skills and Systems-Based Practice	<p>1.2.1 Climate change has broad and profound impacts on human health.</p> <p>1.3.1 Rapid climate mitigation and adaptation are needed to reduce health burdens now and, in the future.</p> <p>1.3.2 Near-term and long-term health co-benefits can be gained from climate mitigation.</p> <p>1.3.3 Health systems can and must enact effective adaptation solutions at the individual and population level.</p> <p>2.1.1 Employ effective communication skills with stakeholders about climate and health topics.</p>
Disaster Preparedness and Emergency Management	OEMs physician need to prepare for disasters including the increasing weather disasters related to climate change. With climate change, planning will need to include both response to acute disasters such as floods and forest fires, as well as anticipatory planning for the longer term effects such as food and water insecurity, population migration, potentially wars, and the prolonged impact on human health.	ACGME: Patient Care, Medical Knowledge, Practice-Based Learning and Improvement, Interpersonal and Communication Skills and Systems-Based Practice	<p>1.1.1 Climate change is one of the greatest threats to human health in the 21st century and urgent action is needed to affect its trajectory.</p> <p>1.1.2 Human health is highly dependent upon planetary health, including a stable climatic system which supports the foundations for all life such as air, water, and food.</p> <p>1.1.3 Climate change is a result of some natural and mostly human drivers.</p> <p>1.1.4 Climate change impacts vary by location and geography.</p> <p>1.1.5 Demographics, economic development,</p>

			<p>technology, and other activities create pressures on the climate and environment.</p> <p>1.2.1 Climate change has broad and profound impacts on human health ...Describe major health outcomes associated with climate events, including both direct and indirect impacts, and their mechanisms.</p> <p>1.5.1 Climate change imposes significant risks to health infrastructure and impacts emergency and disaster planning.</p>
Health and Human Performance	<p>OEM physicians need to be able to explain the concepts of climate mitigation, adaptation and resilience, both in relation to health workplaces and individual employees, and apply the concept of adaptive capacity to the populations they serve, including plans to promote successful adaptation in their worker wellness programs.</p>	<p>Patient Care, Medical Knowledge, Practice-Based Learning and Improvement, Interpersonal and Communication Skills and Systems-Based Practice</p>	<p>1.2.1 Climate change has broad and profound impacts on human health.</p> <p>1.3.1 Rapid climate mitigation and adaptation are needed to reduce health burdens now and, in the future.</p>
Public Health, Surveillance, and Disease Prevention	<p>OEM physicians should apply preventive approaches that include reducing climate change vulnerability and strengthening adaptive capacity. The population health focus of OEM prepares specialists to help our communities, including employers, workers and public health advocates prepare for and adapt to the health threats posed by accelerating climate change.</p>	<p>Patient Care, Medical Knowledge, Practice-Based Learning and Improvement, Interpersonal and Communication Skills, Professionalism and Systems-Based Practice</p>	<p>1.1.1 Climate change is one of the greatest threats to human health in the 21st century and urgent action is needed to affect its trajectory.</p> <p>1.1.2 Human health is highly dependent upon planetary health, including a stable climatic system which supports the foundations for all life such as air, water, and food.</p> <p>1.1.3 Climate change is a result of some natural and mostly human drivers.</p>

			<p>1.1.4 Climate change impacts vary by location and geography.</p> <p>1.1.5 Demographics, economic development, technology, and other activities create pressures on the climate and environment.</p> <p>1.2.1 Climate change has broad and profound impacts on human health.</p> <p>1.3.1 Rapid climate mitigation and adaptation are needed to reduce health burdens now and, in the future.</p> <p>1.3.2 Near-term and long-term health co-benefits can be gained from climate mitigation.</p> <p>1.3.3 Health systems can and must enact effective adaptation solutions at the individual and population level.</p> <p>1.4.1 Planetary Health, Environmental Health, Climate Justice, and Eco-health, Health in All Policies, and One Health are overlapping frameworks which intersect with climate change and health.</p> <p>1.6.1 Global, regional, national, local, and Indigenous environmental data must be utilized to guide health decision making to prevent, prepare for and respond to climate-related events.</p> <p>1.7.1 Health professionals must consider ethical, professional, and legal obligations relevant to climate and health.</p> <p>2.1.1 Employ effective communication skills with</p>
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			<p>stakeholders about climate and health topics.</p> <p>3.1.0 Subnational, national, and global policy frameworks and governance structures are necessary to address health risks associated with climate change.</p> <p>3.2.1 Policies that influence communities' access to resources and affect where they live have profound impacts on vulnerability and adaptive capacity.</p> <p>3.3.1 The voice of health professionals in advocacy and policy is essential to address the climate and health crisis.</p> <p>4.1.1 Climate and health knowledge and skills are applied at all levels of public health action to improve population health and build resilience against climate change.</p> <p>4.2.1 Climate change, biodiversity loss and rapid environmental change affect disease emergence, distribution, and prevalence.</p>
OEM Related Management and Administration	<p>OEM specialists should participate in organizational planning to reduce emissions, decrease carbon footprint and adopt sustainable operations and waste management approaches.</p>	<p>Practice-Based Learning and Improvement, Interpersonal and Communication Skills, Professionalism and Systems-Based Practice</p>	<p>1.3.1 Rapid climate mitigation and adaptation are needed to reduce health burdens now and, in the future.</p> <p>1.3.2 Near-term and long-term health co-benefits can be gained from climate mitigation.</p> <p>1.3.3 Health systems can and must enact effective adaptation solutions at the individual and population level.</p> <p>2.1.1 Employ effective communication skills with</p>

			stakeholders about climate and health topics. 2.2.1 Work collaboratively and across disciplines on climate and health issues.
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²⁴ Hartenbaum NP, Baker BA, Levin JL, et al. ACOEM OEM Core Competencies: 2021. *J Occup Environ Med.* 2021;63(7):e445-e461. doi:[10.1097/JOM.0000000000002211](https://doi.org/10.1097/JOM.0000000000002211)

²⁷ Global Consortium on Climate and Health Education. Climate & health Core Concepts for Health Professionals [Internet]. Columbia Mailman School of Public Health; 2023. <https://www.publichealth.columbia.edu/file/11940/download?token=ILZgbU2L>

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Table 2: ACOEM OEM Competency Domains with Examples Relevant to Climate Change with Proposed ACGME Milestone Changes

1. Clinical OEM Provide clinical care for conditions related to work or environmental exposures; assess the impact of medical conditions on ability to work in a particular environment Representative activity: Treat work injuries Climate-Change Specific Activity: Treat heat-related conditions				
ACGME Milestone Patient Care 2: Clinical Assessment and Management				
Level 1	Level 2	Level 3	Level 4	Level 5
Integrates patient specific information to generate a working diagnosis. Determines indicated tests and initiates a management plan.	Provides a prioritized differential diagnosis using supporting rationale and/or exposure assessment. Orders indicated tests, and initiates a management plan, suggesting work restrictions.	Consistently provides an accurate diagnosis for common occupational and environmental conditions; demonstrates the ability to modify a diagnosis based on a patient's clinical course and additional data. Interprets indicated tests and develops a management plan; determines work restrictions.	Consistently provides an accurate diagnosis for patients with complex occupational and environmental conditions, recognizing sources of diagnostic error. Consistently modifies the management plan based on the patient's clinical course and considers applicable regulatory guidelines. Uses an interdisciplinary, team-based approach while managing complex environmental health hazards.*	Consistently serves as a role model and educator for deriving accurate diagnoses, recognizing sources of diagnostic error, and integrating relevant literature. Implements testing and management plans, integrating patient preferences, evidence-based guidelines, and cost.
e.g. Identifies evidence-based risk factors for heat related illness (including personal, environmental, and medical risk factors) unique to the patient and offers appropriate counseling around risk mitigation based on the patient's risk profile.	e.g. Incorporates climate sensitive and other planetary health specific differential diagnoses into their assessment and plan where appropriate.	e.g. Readily distinguishes between mild manifestations of heat related illness and heat related emergencies including heat stroke and takes appropriate emergent action when necessary.	e.g. Collaborates in Interdisciplinary teams, including industrial hygienists, safety professionals, nurses, epidemiologists, and toxicologists, to assess and manage workplace hazards such as through worksite visits, simulated clinical cases involving students from diverse occupational and environmental health disciplines, or sustainability committees.	e.g. Educates team members on effective patient counseling around wildfire smoke exposure and empowers students and other allied health professionals to play an active role in taking an environmental history on their patients.

2. OEM-Related Law & Regulations

Apply the regulations and voluntary guidelines applicable to occupational and environmental health

Representative activity: Apply OSHA standards to a worker population

Climate-Change Specific Activity: Advocate for occupational heat stress standards at the state and local level

ACGME Milestone Medical Knowledge 3: Regulatory

Level 1	Level 2	Level 3	Level 4	Level 5
Identifies relevant occupational and environmental regulatory agencies. Identifies occupational or environmental regulations/guidelines regarding exposure in a specific industry or geographic area.	Lists the regulatory requirements for a specific industry. Identifies the recommended/mandated exposure limits for a specific substance or hazard. Identifies regulatory gaps in worker protection/environmental health/climate change.*	Applies knowledge of pertinent regulatory standards, to an individual worker. Reviews exposure monitoring results for an individual and prepares written reports for employers, workers, or government.	Applies knowledge of regulatory requirements to develop or modify a workplace policy (actual or simulated). Interprets and applies exposure monitoring results to work setting or clinical cases. Provides guidance on workplace/environmental hazards/climate change including situations where gaps exist in current regulations.*	Participates in developing or modifying a regulatory requirement or guideline. Prepares a written exposure monitoring and reporting system plan for a specific workplace or other defined entity. Advocates for regulations to address gaps in worker health/environmental health/climate change.*
e.g. Demonstrates familiarity with federal and state occupational safety and health regulations on heat exposure for outdoor workers.	e.g. Describes the EPA criteria air pollutants and related regulations in relation to the Air Quality Index (AQI) and how that could be applied to protect workers.	e.g. Demonstrates comfort with communicating risks coupled with a comprehensive understanding of both local and national safeguards for workers amidst the challenges posed by hurricane season.	e.g. Undertakes a quality improvement project to provide guidance to an industry with outdoor workers on heat illness prevention in accordance with state and federal heat standards as applicable	e.g. Collaborates and advocates with local, regional, or national regulatory agencies to update protections for workers based on evolving literature on heat exposure and mitigation strategies.

3. Environmental Health

Recognize potential chemical, physical, and biological environmental causes of health concern to the individual as well as to community health

Representative activity: Evaluate a cancer cluster in relation to exposure to local industrial toxicants

Climate-Change Specific Activity: Evaluate a cluster of chronic kidney disease in agricultural workers

ACGME Milestone Systems-Based Practice 3: Population Health

Level 1	Level 2	Level 3	Level 4	Level 5
Demonstrates knowledge of population and community health needs and disparities	Identifies specific population and community health needs and inequities for their local population Describes how climate-resilience initiatives can impact: community health, healthcare costs, and environmental justice*	Uses local resources effectively to meet the needs of a patient population and community.	Participates in changing and adapting practice to provide for the needs of specific populations	Leads innovations and advocates for populations and communities with health care inequities
e.g Demonstrates knowledge of health disparities in communities disproportionately impacted by a local landfill	e.g. Describes initiatives to reduce methane generation from livestock	e.g.. Provided education for pregnant workers who live/work in an urban heat island setting with tools to reduce their heat exposure	e.g Evaluates local risks for flooding, water degradation and wildfires.	e.g. Performs evidence based policy work through local medical professional society with oral testimony or with written material

4. Work Fitness & Disability Management

Determine whether a worker can safely be at work and perform required job tasks, including the ability to perform work in a variety of conditions

Representative activity: Evaluate ability to lift and carry objects over a work shift

Climate-Change Specific Activity: Evaluate ability to perform specific work tasks at temperature extremes and in low air quality conditions

ACGME Milestone Patient Care 4: Fitness for Work (Workers' Compensation, Employment and Certification Exams, Fitness for Duty, Return to Work)

Level 1	Level 2	Level 3	Level 4	Level 5
Identifies types of work restrictions Identifies elements of an examination to determine fitness for different types of work	Suggests work restrictions or return to work plan in the context of a management plan for patients Conducts examinations determining fitness for work in a variety of industries Identifies the elements of work fitness and disability determination	Provides work activity prescriptions in the context of a management plan for patients, interacting with care teams Performs fitness for duty/work examinations with knowledge of regulations and guidelines Performs medical evaluations using the principles of work fitness and disability determination	Consistently provides work activity prescriptions in complex patient management situations, interacting with care teams Consistently performs complicated fitness for duty/work examinations with knowledge of regulations and guidelines Participates in a disability determination or impairment assessment	Serves as a role model for providing work activity prescriptions in complex patient management situations Serves as a role model for performing complicated fitness for duty/work examinations Performs a disability determination or impairment assessment and causation analysis
e.g. Determines appropriate return-to-work plan for a construction worker seen for heat stress	e.g. Recommends heat acclimatization schedule for team of new outdoor workers	e.g. Evaluates workers entering a high-temperature toxic environment in OSHA level A PPE for fitness to carry out work activities	e.g. Reviews medical documentation in case of myocardial infarction in a wildland firefighter against National Fire Protection Association standards to determine appropriate return-to-work decision	e.g. Evaluates an agricultural worker with chronic kidney disease for work environmental contribution, making causation determination and return-to-work recommendations.

5. Toxicology

Recognize, evaluate, and manage health effects of exposures to toxic agents at work or in the general environment

Representative activity: Develop a plan to control exposure to antineoplastic agents in a cancer treatment facility

Climate-Change Specific Activity: Develop a mitigation plan to protect hazmat workers from uncharacterized toxicants in flooded areas

ACGME Milestone Patient Care 5: Toxicology

Level 1	Level 2	Level 3	Level 4	Level 5
<p>Demonstrates knowledge of basic pathophysiology, pharmacology, and metabolism of drugs and toxicants</p> <p>Demonstrates knowledge of major classes of environmental pollutants and toxicants related to climate change and their health impacts.*</p>	<p>Evaluates patients using knowledge of basic toxicological principles, including routes of exposure and metabolic pathways</p> <p>Examines how climate change impacts the distribution of environmental pollutants and toxicants. Identifies populations and systems most susceptible to climate-related toxicological impacts.*</p>	<p>Evaluates and recommends care for patients whose health may be affected by occupational or environmental toxic exposures, including interpretation of laboratory and/or environmental monitoring test results including those arising from climate change</p> <p>Conducts a risk assessment incorporating a climate-focused environmental history.*</p>	<p>Assesses clinical, worksite, and environmental data, recommends treatment of acute or chronic occupational or environmental toxic exposures, and work restrictions or exposure control measures</p> <p>Assesses and treats patients who have been directly affected by environmental pollutants and toxicants resulting from climate-related impacts. Analyzes relevant data sources (including diagnostics, laboratory tests, publicly-available pollution data) and applies knowledge directly to patient care.*</p>	<p>Performs complex causation analysis of patients with symptoms or conditions and/or conducts screening and surveillance for populations that may be related to occupational or environmental toxic exposures, and effectively communicates risk</p> <p>Performs a thorough exposure assessment applying current environmental toxicology methodology at the individual and population levels.</p> <p>Uses resources like the National Climate Assessment to develop national climate projections and perform risk stratification at the regional level for direct clinical application*</p>
<p>e.g. Discusses the subject of persistent Organic Pollutants (POPs) which are toxic chemicals that persist in the environment, bioaccumulate through the food web, and pose risks to human health and the environment. Climate change exacerbates the</p>	<p>e.g. Identifies that urban poor in areas prone to higher levels of air pollution intensifying urban heat island effects.</p>	<p>e.g. Conducts a respiratory assessment for patients exposed to increased air pollution or wildfire smoke.</p>	<p>e.g. Reviews data from local air quality monitoring stations to identify pollutants like particulate matter (PM_{2.5}), ozone, and volatile organic compounds (VOCs).</p>	<p>e.g. Assesses wildfire pollutants: identify contaminant sources; the environmental fate and transport of toxicants across different media (air, water, soil); determine exposure points where people may come into contact with these pollutants.</p>

distribution and impact of these pollutants.				
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6. Hazard Recognition, Evaluation & Control

Assess risk of an adverse event from exposure to physical, chemical, biological, or psychosocial hazards in the workplace or environment

Representative activity: Collaborate with industrial hygiene and engineering team members to evaluate the risk of exposure to nanoparticles in a new process

Climate-Change Specific Activity: Collaborate with the local health department to evaluate impact from redistribution of toxic soil contaminants from local flooding

ACGME Milestone Medical Knowledge 1: Hazard Recognition and Management

Level 1	Level 2	Level 3	Level 4	Level 5
<p>Discusses how occupational and environmental risk factors contribute to injury and illness</p> <p>Articulates how climate-related hazards can increase a worker's susceptibility to acute and chronic illness.</p>	<p>Demonstrates knowledge of core principles of industrial hygiene, ergonomics, occupational safety, risk assessment and communication, and hazard controls</p> <p>Demonstrates knowledge of how to conduct climate-specific risk and hazard assessments for a worker population.</p>	<p>Participates in activities or consultations that include application of the principles of industrial hygiene, ergonomics, occupational safety, risk assessment, and hazard control to patients, populations, and/or employer/employee organizations that include identifying climate-induced occupational hazards among others*</p>	<p>Applies core principles of risk assessment and hierarchy of controls to reduce risks from industrial hygiene, ergonomic, and safety hazards to patients, populations, and/or employee/employer organizations, and communicates risks</p> <p>Formulates adaptation and/or mitigation strategies for employers to implement with identified occupational hazard that is climate-related.</p>	<p>Interprets, analyzes, and applies the principles of industrial hygiene, ergonomics, occupational safety, risk assessment, hazard control in complex occupational or community environments and communicates risks effectively</p> <p>Integrates climate adaptation and mitigation strategies into organizational policy development.</p> <p>Uses historical data, real-time data, and climate models to project future risks</p>
<p>e.g. Agricultural worker exposed to high temperatures can lead to heat stress, heat exhaustion, heat stroke (acute) and cardiovascular disease, kidney dysfunction (chronic)</p>	<p>e.g. Evaluating a landscaping company's workforce and evaluating who is at most-risk for a heat-related event.</p>	<p>e.g. While visiting a warehouse during the summer months, it is found that there is no air conditioning, no fan; no administrative controls have been implemented.</p>	<p>e.g. Acclimatization program for new hires to a construction company starting in the summer months.</p>	<p>e.g. Develop a blueprint for a company to reduce its greenhouse gas emissions by 50% by 2030 and achieve net-zero emissions by 2050.</p>

7. Disaster Preparedness & Emergency Management

Protect employees, organizations and the community by anticipating and preventing the consequences of a broad range of physical, chemical, biological, or psychosocial threats

Representative activity: Develop and implement a pandemic response plan for a company, in collaboration with other organizational leaders

Climate-Change Specific Activity: Collaborate with other leaders to identify relevant local climate change vulnerabilities and develop a plan to mitigate health and economic effects

ACGME Milestone ACGME Milestone Medical Knowledge 1: Hazard Recognition and Management

Level 1	Level 2	Level 3	Level 4	Level 5
<p>Discusses how occupational and environmental risk factors contribute to injury and illness</p> <p>Recognizes health risks expected with local extreme weather events or climate disasters*</p>	<p>Demonstrates knowledge of core principles of industrial hygiene, ergonomics, occupational safety, risk assessment and communication, and hazard controls</p> <p>Demonstrates ability to use climate-related data systems to characterize current impact and anticipate risks*</p>	<p>Participates in activities or consultations that include application of the principles of industrial hygiene, ergonomics, occupational safety, risk assessment, and hazard control to patients, populations, and/or employer/employee organizations</p> <p>Participates in activities that prepare an organization to protect its workers from the short- and long-term effects of climate change*</p>	<p>Applies core principles of risk assessment and hierarchy of controls to reduce risks from industrial hygiene, ergonomic, and safety hazards to patients, populations, and/or employee/employer organizations, and communicates risks</p> <p>Participates in developing organizational mitigation plan in case of a climate disaster*</p>	<p>Interprets, analyzes, and applies the principles of industrial hygiene, ergonomics, occupational safety, risk assessment, hazard control in complex occupational or community environments and communicates risks effectively</p> <p>Uses the range of available online resources to project climate-change related threats to a worker population, and communicates these effectively*</p>
e.g. Identifies workers at risk for particulate air pollution health effects based on job duties	e.g. Conducts research using local health surveillance systems for trends in emergency department visits related to increasing air particulates from smoke drift	e.g. Develops a tabletop exercise to test an organization's emergency response plans in the event of a flood causing power outage and impeding evacuation.	e.g. Outlines a disaster preparedness plan for patient protection for a long-term care facility in the event of prolonged power outage without ability to evacuate (e.g. flood)	e.g. Uses information about vibrio and other microorganisms in local water to develop a mitigation and education plan for emergency response workers in a flood

8. Health and Human Performance

Identify and address individual and organizational factors in the workplace toward optimizing worker health and enhancing human performance

Representative activity: Develop, launch and measure the impact of a workplace smoking cessation program

Climate-Change Specific Activity: Plan a workplace health promotion campaign to increase capacity for climate adaptation and resilience

ACGME Milestone Patient Care 3: Worker Health, Well-Being, and Performance Optimization

Level 1	Level 2	Level 3	Level 4	Level 5
<p>Discusses how individual and organizational factors in the workplace can influence health, well-being, and performance</p> <p>Recognizes the gradual impact of climate change as a health threat to be managed*</p>	<p>Identifies individual and organizational factors in the workplace which influence the health, well-being, and performance of workers</p> <p>Identifies biologic, social, and structural factors that make individuals and populations more vulnerable to health impacts from climate change*</p>	<p>Describes the use and limitations of health risk assessment and screening for well populations, and the applications of screening, assessment, and early intervention for targeted high-risk groups</p> <p>Explains how health outcomes in response to climate events will vary within and among different communities and regions*</p>	<p>Monitors and surveys at least one workforce, and interprets monitoring and surveillance data to enhance the health, well-being, and performance of workers (simulation or actual)</p> <p>Recognizes, anticipates and plans for the mental and emotional adjustments in workers facing climate change threats*</p>	<p>Designs, implements, and evaluates worksite health promotion programs independently, incorporating authoritative guidelines and evidence</p> <p>Distinguishes among primary, secondary, and tertiary levels of prevention as they relate to reducing vulnerability and strengthening adaptive capacity related to climate change*</p>
<p>e.g. Develops a workplace exercise challenge that incorporates considerations of outdoor temperature extremes and access to air-conditioned facilities for all employees</p>	<p>e.g. Considers the work-life balance impact of a planned work schedule adjustment to earlier start times for outdoor workers</p>	<p>e.g. Modifies a company health risk assessment to incorporate exposure to temperature extremes, access to air conditioning, and risk for vector-related illness depending on activities</p>	<p>e.g. Conducts an eco-anxiety survey of the workforce and makes recommendations to organizational management based on the results</p>	<p>e.g. Develops a workplace health promotion program for warehouse workers that includes a heat acclimatization plan, hydration, cooling breaks, seasonal schedule adjustments and mental health support in addition to standard personal risk factor modification</p>

9. Public Health, Surveillance & Disease Prevention

Assess and respond to individual and population risks for common occupational and environmental disorders as well as emerging and catastrophic events; measure, organize and improve public health service or a surveillance system

Representative activity: Plan and manage an occupational injury surveillance program, incorporating mitigation plans based on trend data

Climate-Change Specific Activity: Interpret local air quality data related to wildfire particulate pollution and apply this to mitigate the impact on an outdoor worker population

ACGME Milestone Patient Care 6: Surveillance

Level 1	Level 2	Level 3	Level 4	Level 5
Demonstrates working knowledge of basic principles underlying screening and surveillance Demonstrates working knowledge of screening and surveillance for workers impacted by the climate*	Performs a medical surveillance examination following prescribed regulations and guidelines; communicates results as indicated	Independently identifies which tests and actions are recommended or mandated for a specific worker	Prepares a valid aggregate analysis and summary of actual medical surveillance examinations for a specific focus, such as lead-exposed workers, lipid screening, hearing conservation, impacts from climate change* (actual or simulated)	Develops a comprehensive program plan for a workplace, including test selections, follow-up plans, and comparison of cost effectiveness of alternative strategies
e.g. Demonstrates the purpose of performing a baseline exam on an outdoor worker who applies pesticides	e.g. Communicate results of a medical surveillance exam of outdoor workers and makes appropriate recommendations reduce heat illness	e.g. Determines if spirometry, chest x-ray, is needed for workers exposed to airborne pollutants	e.g. Assesses trends in spirometry of a large cohort of workers exposed to airborne pollutants	e.g. Utilizing data from a variety of sources, develops a comprehensive plan to mitigate impacts of wildfire particulate pollution on outdoor workers to present to various stakeholders with cost comparison

10. OEM-Related Management & Administration

Plan, design, implement, manage, and evaluate comprehensive occupational and environmental health programs and projects and work with leadership and governance to ensure the health and safety of employees.

Representative activity: Apply primary, secondary, and tertiary preventive approaches in developing and measuring the impact of a workplace bloodborne pathogens program

Climate-Change Specific Activity: Conduct an evaluation of the pros and cons of reducing disposable glove use in a hospital setting, considering both infectious disease risks and climate impacts.

ACGME Milestone Systems-Based Practice 4: Physician Role in Health Care Systems

Level 1	Level 2	Level 3	Level 4	Level 5
<p>Identifies key components of the complex health care system (e.g., hospital, skilled nursing facility, finance, personnel, technology)</p> <p>Describes basic health payment systems, (e.g., employer, government, private, public, uninsured care) and practice models</p> <p>Identifies basic knowledge domains for effective transition to practice (e.g., information technology, legal, billing and coding, financial, personnel)</p>	<p>Describes how components of a complex health care system are interrelated, and how this impacts patient care</p> <p>Delivers care with consideration of each patient's payment model (e.g., insurance type)</p> <p>Describes core administrative knowledge needed for transition to practice (e.g., contract negotiations, malpractice insurance, governmental regulation, compliance)</p>	<p>Discusses how individual practice affects the broader system including sustainability*</p> <p>Engages with patients in shared decision making, informed by each patient's payment models</p> <p>Demonstrates use of information technology required for medical practice (e.g., clinical decision support tools, documentation required for billing and coding)</p>	<p>Manages various components of the complex health care system to provide efficient and effective patient care and transition of care</p> <p>Advocates for patient care needs (e.g., community resources, patient assistance resources) with consideration of the limitations of each patient's payment model</p> <p>Analyzes practice patterns and professional requirements in preparation for practice</p>	<p>Advocates for or leads systems change that enhances high-value, efficient, and effective patient care and transition of care</p> <p>Participates in health policy advocacy activities including those related to climate mitigation initiatives particularly addressing vulnerable populations such as outdoor workers *</p> <p>Educates others to prepare them for implementation.</p>
e.g. Can describe the greenhouse gas contributions of the health care systems	e.g. Describes how a patient safety activity such as use of disposable gloves containing PVC and similar components contribute to excess waste and how to replace them with more sustainable alternatives that meet labor standards without compromising patient safety or care	e.g. Discusses climate mitigation strategies with patients such as avoiding use of single use plastics	e.g. While looking for ways to reduce supply chain costs for a healthcare system, identified a carbon accounting calculator to determine Scope 3 emissions.	e.g. Collaborates with stakeholders such as public health agencies, professional membership societies, community groups to reduce greenhouse gas emissions from a local landfill

Table 1: * Bolded areas are suggested changes

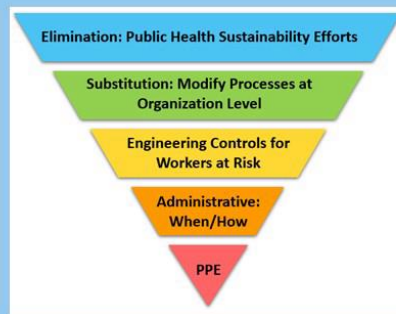
There are gaps in climate change health education in occupational and environmental medicine residency programs. Educators will be empowered to enhance residency training through the proposed revisions to the ACOEM competencies and ACGME milestones which will in turn safeguard worker health from the climate change crisis.

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How can we prepare OEM specialists to be even better leaders in climate change?

ACOEM Core OEM Competencies need more climate change emphasis including sustainability, resilience and mitigation of the effects on workers.

NIOSH Hierarchy of Controls Applied to Climate Change



OEM residency programs must include more activities directed toward climate change anticipation, mitigation and adaptation.

The Imperative to Incorporate Climate Change Competencies into Occupational and Environmental Medicine Training to Safeguard Worker Health
Khan, Alya; Berenji, Manijeh; Cloeren, Marianne; Goldman, Rose; Wheat, Stefan; Ogunseitan, Oladele; Ayoub, Samantha; Rabinowitz, Peter; Chekuri, Bhargavi; Solomon, Gina

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