Clinical Implications of Climate Change on US Emergency Medicine: Challenges and Opportunities

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The adverse influences of climate change are manifesting as health burdens relevant to clinical practice, affecting the very underpinnings of health and stressing the health care system. Emergency medicine is likely to bear a large burden, with its focus on urgent and emergency care, through its role as a safety-net provider for vulnerable populations and as a leader in disaster medicine. Clinically, climate change is affecting emergency medicine practice through the amplification of climate-related disease patterns and epidemiologic shifts for conditions diagnosed and treated in emergency departments (EDs), especially for vulnerable populations. In addition, climate-driven intensification of extreme weather is disrupting health care delivery in EDs and health care systems. Thus, there are significant opportunities for emergency medicine to lead the medical response to climate change through 7 key areas: clinical practice improvements, building resilient EDs and health care systems, adaptation and public health engagement, disaster preparedness, mitigation, research, and education. In the face of this growing health threat, systemwide preparation rooted in local leadership and responsiveness is necessary to efficiently and effectively care for our vulnerable communities. [Ann Emerg Med. 2020; ]

The adverse health effects of climate change are now apparent and present urgent and complex challenges for emergency medicine.1 In this century, the increasing concentration of anthropogenic greenhouse gases has led to the increasing temperature of our planet, with escalating extreme heat, intensification of extreme weather (e.g., wildfires, flooding), and rising sea levels.2 Subsequent downstream climate exposures, such as degraded air, food, and water quality and increases in vector-borne disease, result in cascading negative health effects and health care disruptions. Such events often result in surges in demand for emergency medicine services, which may result in prolonged boarding times, staffing shortages, worker fatigue, and poor patient outcomes,3 depending on systemwide capacity and preparedness. Furthermore, many climate exposures result in long-lasting effects, eroding the health of our communities and exacerbating poverty, potentially driving up health care needs for chronic disease and mental health.2 Although all individuals are at risk of experiencing climate-related adverse health outcomes, many are disproportionately affected, particularly vulnerable and marginalized populations who rely heavily on the emergency department (ED) as their primary point of health system access. Climate change stresses many aspects of the health system; however, emergency medicine, on the front line of acute care nationwide, stands to bear a large burden.4

Systemwide preparation of the health care sector, rooted in local leadership and responsiveness, is necessary to effectively address current and future health influences from climate change. Emergency medicine has a unique opportunity and imperative to lead. Through its role in the health care system as an acute care provider, a safety net for vulnerable populations, and a leader in disaster medicine, emergency medicine is already deeply involved in caring for patients most negatively affected.3

Our objective is to first provide a contemporary description of the influences of climate change on the clinical practice of emergency medicine in the United States, calling attention to disproportionate effects on vulnerable populations and exploring the unique threats from weather-related disasters. Our second objective is to explore novel approaches for clinical intervention and propose a framework.
through which emergency medicine can address current and future risks.

**IMPACTS OF CLIMATE-SENSITIVE DISEASES ON EMERGENCY MEDICINE**

In the United States, ED visits have steadily increased during the past 10 years and are currently estimated at 131 million annually, providing nearly half of US medical care. \(^6\) The climate contribution to this increase in utilization is currently unknown. Here we present common emergency medicine diagnoses known to be affected by climate change (Table 1), acknowledging that new links between climate change and health continue to be discovered.

**Heat-Related Disease**

During the past 15 years, there has been an increase in the frequency, intensity, and duration of heat waves (periods of abnormally hot weather), with 175 million people worldwide exposed in 2015. \(^7\) Surface temperatures are projected to continue increasing by 2°C to 4°C by 2100. \(^8\) Higher temperatures increase the water-carrying capacity of the atmosphere, thereby additionally affecting humidity and precipitation. Multiple lines of evidence show a clear association between heat exposure and mortality, particularly among the most physiologically and socioeconomically vulnerable. \(^2,9\) Heat-related emergencies have been extensively reviewed elsewhere in the literature. \(^10\) However, in addition to heat illness, heat waves and even small increases in average temperature are often followed by increases in all-cause ED usage because of a broad range of exacerbated health conditions, including chronic renal, cardiovascular, and pulmonary disease. \(^11\) These effects are often excluded from traditional heat-impact analyses (ie, focused on classically defined heat illnesses), yet may translate to increased ED utilization and demand for emergency medical services (EMS).

**Respiratory Disease**

Environmental respiratory irritants ozone and fine particulate matter inflame airways and enter the bloodstream, where they ultimately aggravate respiratory and cardiovascular disease, increasing the risk of premature death. \(^2\) The combustion of fossil fuels increases ground-level ozone and fine particulate matter, and increasing ambient temperatures accelerate the formation of ozone. Literature suggests that exposure to ground-level ozone and fine particulate matter results in increased ED utilization for chronic obstructive pulmonary disease and asthma. \(^12,13\)

Wildfires, driven by factors such as drought, dry winds, and high ambient temperatures, have been increasing in frequency and intensity since the mid-1980s. \(^2\) The complex mixtures of respiratory irritants released in wildfires may reduce lung function and inflame airways even among relatively distant populations. \(^14\) Wildfires are associated with regionwide surges in ED presentation for acute respiratory complaints, including chronic obstructive pulmonary disease, asthma, and dyspnea. \(^15,16\)

**Cardiovascular and Cerebrovascular Disease**

As previously discussed, heat waves are associated with significant cardiovascular morbidity and mortality, and the risk of an acute event increases with only moderate increases in seasonal temperature. \(^17\) In addition, acute ischemic strokes are the fifth leading cause of death in the United States and are also more common during heat waves. \(^18,19\) Poor air quality and ozone exposure have been associated with increased ED presentations for cardiovascular complaints, arrhythmias, and ischemic heart disease. \(^20,21\) Data in regard to the effect of wildfire exposure on cardiovascular disease are mixed, potentially because of the heterogeneous composition of wildfire smoke. \(^15,22\)

**Waterborne Gastrointestinal Disease**

Environmental factors related to climate change, such as warming of the oceans, along with increased frequency and intensity of heavy downpours alter marine and freshwater resources in a manner that increases human exposure to disease-causing organisms. \(^2\) Increasing sea temperatures increase the growth of waterborne pathogens, including harmful algae blooms and ciguatera poisoning, as well as *Vibrio parahaemolyticus*, a leading cause of seafood-associated gastroenteritis. \(^2\) Heavy rainfall events can overwhelm sewage and water treatment facilities and increase runoff, which has been associated with increased levels of pathogens in drinking water, gastrointestinal disease outbreaks, and surges in demand for ED services, although data and reports are limited to specific geographic areas. \(^23,24\)

**Vector-Borne and Zoonotic Disease**

Microbial pathogens and their vectors are sensitive to climate conditions that delineate environmental limits on the geographic range, seasonality, and transmission. Evidence supports that climate change may expose more people to endemic tick-borne and mosquito-borne illnesses, such as Lyme disease, Zika virus, West Nile virus, dengue virus, and chikungunya. \(^2,27\) International outbreaks of vector-borne diseases in other countries can also affect the United States and increase risk of sustained local transmission in suitable locations and populations, with
Table 1. Examples of climate-sensitive diseases presenting to EDs in the United States.

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<td>Respiratory disease</td>
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<td>Three times as many Americans reported illnesses from vector-borne disease&lt;sup&gt;69&lt;/sup&gt; in 2016 as in 2004. Emerging climate-sensitive diseases include Lyme disease&lt;sup&gt;7&lt;/sup&gt; Zika virus&lt;sup&gt;25&lt;/sup&gt; Dengue virus&lt;sup&gt;7&lt;/sup&gt; West Nile virus&lt;sup&gt;70&lt;/sup&gt;</td>
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<td>Mental health</td>
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COPD, Chronic obstructive pulmonary disease.
significant implications for emergency medicine. For example, the Zika epidemic in the Americas, which may have been facilitated by permissive climatic conditions that increased mosquito vector abundance,\(^25\) led to $1.1 billion of US public spending for emergency response. Globally, the vector capacity of *Aedes aegypti* is increasing, and its range is expected to double by the end of the century, with much of the increased range projected to occur in North America, potentially allowing for the spread of several vector-borne diseases.\(^\)\(^\)\(^\)\(^\) Moreover, in the aftermath of climate-related disasters, receding floodwaters create ideal environments for mosquito breeding, which in turn may increase vector-borne disease transmission. Given that the ED serves as the front line for detection and diagnosis of emerging diseases,\(^5\) the changing geography and prevalence of vector-borne disease means that emergency physicians should maintain a high index of suspicion for novel, nonendemic diseases in their communities.

**Accidental and Nonaccidental Trauma**

Both increasing ambient temperatures and extreme weather disasters may be associated with surges in ED utilization for trauma. Evidence suggests that increasing daily temperature is associated with the frequency of trauma presentations\(^26-28\) and admissions.\(^29\) Additionally, a number of studies spanning a range of spatial and temporal scales have found relationships between temperature, aggression, and violent crime.\(^30,31\) Heat is also an independent risk factor for accidental injuries in both indoor and outdoor occupations, with elevated risk occurring at temperatures less than would constitute a heat wave.\(^32\) Last, traumatic injuries constitute a majority of the direct mortality during extreme weather events, as discussed later.\(^33\)

**Mental Health**

In the United States, mental health emergencies factor into at least 1 of every 8 ED visits.\(^34\) Climate change affects mental health in myriad ways, which can result in increased demand for emergency mental health services. For example, climate-related disasters resulting in forced displacement and loss of livelihood and community stability are associated with an increased risk of posttraumatic stress disorder, depression, anxiety, and substance abuse that can persist for years among survivors.\(^35\) Additionally, disasters have been associated with increased rates of sex-based violence, including rape and domestic violence.\(^36,37\) EDs play a critical role in victim assistance and advocacy and are the primary access point for the mental health system.

Patients with mental health concerns also have unique vulnerability to climate hazards not only from diminished capacity to respond or adapt but also as a result of psychotropic medications, which interfere with centrally regulated thermoregulation and place these populations at elevated risk of heat illness.\(^3\) There have been a small number of studies showing increased ED visits and psychiatric hospitalizations on extremely warm days,\(^38\) particularly for schizophrenia.\(^39\) Extreme weather events have been associated with increases in aggressive behavior and domestic violence, substance abuse, suicide, and emergency medicine mental health admissions.\(^40\)

**VULNERABLE POPULATIONS**

As the de facto safety net for the health care system, emergency medicine is uniquely positioned to address the ways in which climate change threatens to widen existing health inequities and disproportionately worsen health outcomes for vulnerable individuals. Vulnerability may arise from physiologic, cultural, and socioeconomic factors, which are amplified by climate-related exposures and limited access to health care (Table 2).

Ultimate health outcomes for vulnerable individuals depend on a multitude of factors, many of which are modifiable. They include health care system access and readiness, quality of care, and protective public health measures (eg, early-warning systems). Emergency physicians have the ability to positively affect health outcomes for these patients in many ways, described later.

**EFFECTS OF CLIMATE-SENSITIVE EXTREME WEATHER DISASTERS ON HEALTH CARE DELIVERY**

The frequency of extreme weather events (hurricanes, floods, wildfires, heat waves, etc) in the United States is increasing, causing injury, illness, disruption in medical treatment, exacerbation of disease, population displacement, and adverse mental health effects, all of which significantly increase demand for ED resources in the short and long term.\(^13\) Simultaneously, extreme weather events are unique in that not only are individual patients affected but also health care infrastructure is affected, with consequences for patient care.

The acute phase of an extreme weather event encompasses the immediate effects and ED utilization surges for drownings, electrocutions, and physical trauma shortly after the event onset.\(^33,41\) This phase is associated with the majority of directly attributable mortality.\(^42\) The acute phase is also associated with abrupt population displacement. EDs, even more than baseline, serve as the
default primary care point of access for affected populations, which can result in regionally increased volumes, longer wait times, and increased medical and mental health staffing and supply needs. Communities receiving displaced populations may also experience changes in disease prevalence and geographically novel diseases.

Simultaneously, the acute phase can be associated with significant destruction to health care infrastructure, which presents complex challenges to patient care. Effects may include physical damage to structures, loss of primary and backup power (because of direct damage as well as surges in demand during heat waves), loss of potable water, and disruption of critical supply chains (Figure 1). Loss of power means loss of ventilators, monitors, dialysis machines, refrigeration, radiology and laboratory equipment, elevators, heating and cooling, lights, communication systems, and other critical equipment necessary to remain operational. Simultaneous patient surges may result in deficits of critical physical, medicinal, and human resources. If local hospitals are critically damaged, the patient burden will fall on surrounding EDs, putting regionwide pressure on resources and staffing.

In the days to weeks after disasters, increased ED usage is expected for acute exacerbations of chronic disease because of a lack of medications and loss of access to primary care. For example, in the weeks after Hurricane Sandy (2012), surges in ED visits occurred for diabetic complications, myocardial infarctions, and tachyarrhythmias attributable to treatment...
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In California, 2018 was the most destructive fire year in history, with more than 1.8 million acres burned.48 In November of 2018, at least 3 hospitals, 6 intermediate care facilities, and 4 congregate living facilities were evacuated49 and 85 people were killed.50 Rapid evacuation puts patients at risk of injury and deterioration, simultaneously risking the health of providers. Such widespread destruction has led to an urgent call for building health care facility and system resilience.51

Another concern is company action taken during hot, dry, and windy conditions during fire seasons. In 2019, Pacific Gas and Electric Company shut off power for days to nearly 250 hospitals and thousands of customers to minimize fire risk.52 The health effects of this shutoff have not been quantified, but effects likely occurred to both health centers and individual patients. For example, among smaller community health centers, 97% rely on refrigeration for medications and vaccinations, and only 44% have any backup power.53 Electricity is also relied on for home oxygen use and medical device use and home cooling. As projected climate conditions continue to foster large destructive wildfires, health care facilities and employees will be forced to prepare and respond.

**Figure 1.** Case study: wildfires in California.

Interruptions.45,46 Surges in ED utilization are also observed from exposure to floodwaters or contaminated drinking water resulting in gastrointestinal illness, wound infections, and otolaryngologic infections.47 The populations most profoundly affected in the subacute phase have been characterized as the most resource vulnerable who already experience a disproportionate burden of chronic disease and are most likely to seek emergency care.48

Finally, disasters have long-term health consequences. Flooding can result in mold contamination of living spaces, resulting in chronic respiratory diseases. Likewise, damaged shelters may increase exposure to vector-borne diseases from disruption to the integrity of screens, windows, and doorways. Displaced persons without access to primary care are likely to experience exacerbations of chronic illness as a result of lack of medications and treatment, and forced displacement from a disaster is associated with an increased risk of depression, posttraumatic stress disorder, substance use, and anxiety.

**OPPORTUNITIES FOR EMERGENCY MEDICINE TO IMPROVE HEALTH AND HEALTH CARE DELIVERY**

As the climate crisis threatens to disrupt health care delivery, emergency medicine has the opportunity to mitigate exposures and improve health outcomes. Abundant opportunities with various degrees of engagement exist for emergency providers to apply a climate lens to their practice. Key areas for emergency medicine engagement are outlined in Figure 2.

**Clinical Practice Recommendations**

There are significant opportunities for emergency medicine practitioners to reduce patient vulnerability by applying climate-aware clinical decisions and behavioral interventions to care plans.52 In addition, clinicians often evaluate patients during times of critical exposures, with a significant opportunity for timely education that can minimize morbidity and mortality (Table 3).

**Building Resilient EDs and Health Care Systems**

The Intergovernmental Panel on Climate Change defines “resilience” as the “capacity of a system to cope with a hazardous event or disturbance, responding or reorganizing in ways that maintain its essential function, while also maintaining the capacity for adaptation, learning and transformation.” As the health care system interface for any public disaster, emergency medicine has both the credibility and expertise to lead transformation.

Best practices for health care resilience have originated at the federal level. The US Department of Health and Human Services developed the Sustainable and Climate Resilient Health Care Facilities Toolkit, partially in response to hospitals forced to close and evacuate during disasters, with devastating losses in infrastructure assets and negative effects on patient. For example, as a result of Hurricane Sandy, Hoboken University Medical Center and Palisades Medical Center were evacuated; the Manhattan campus of the Veterans Affairs New York Harbor Health System, Coney Island Hospital, and New York Downtown Hospital had to close; and 26 additional residential care facilities evacuated more than 6,400 patients.54

Other hospitals have demonstrated effective crisis resiliency plans both in terms of minimizing infrastructure damage and maintaining care continuity during disasters, as was demonstrated at the Texas Medical Center during Hurricane Harvey.

**Adaptation and Public Health Engagement**

In a 2018 policy statement, the American College of Emergency Physicians (ACEP) recommended that emergency medicine liaise with public health agencies to expand and improve regional surveillance systems of emerging diseases related to extreme weather events linked to climate change.4 EDs are ideal focal points for epidemiologic surveillance and are already central to many syndromic surveillance activities. For example, New York City has developed a system that tracks heat-related EMS
Figure 2. Opportunities to for emergency medicine to improve health and health care delivery.

Key Areas of Emergency Medicine Engagement With the Climate Crisis

1. Clinical Practice Improvements: In the clinical setting, emergency physicians as well as primary care and other specialty physicians can improve patient outcomes by applying a climate lens to bedside care.

2. Building Resilient EDs and Health Care Systems: Driven by local climate vulnerability assessments and rooted in emergency medicine leadership, EDs and health care systems can strategically strengthen infrastructure and processes to become resilient in the face of climate threats.

3. Adaptation and Public Health Engagement: Emergency medicine must continue to strengthen partnerships with public health entities to pioneer efforts that protect health, such as to early-warning systems and epidemiologic surveillance.

4. Disaster Preparedness: Emergency medicine and affiliated EDs can assess geographic and systemic vulnerabilities to disasters and increase coordination and communication with other local health entities and relevant specialties within and outside the medical community.

5. Mitigation: EDs can systematically reduce their carbon footprint and spur larger health system changes through interventions that improve energy resource management and operational expenditures.

6. Research: Emergency medicine can lead interdisciplinary research to both better understand the health and health care system effects of climate change and develop an evidence-based approach for adaptation and health protection.

7. Education: Emergency medicine can incorporate climate medicine and a climate lens into clinical practice education for trainees, as well as increase learning opportunities for medical students, residents, fellows, and medical professionals through continued medical education.

dispatches and data from ED triage logs, which have successfully been used to detect spikes in heat-related deaths and to inform public health systems and ED preparedness. Such coordinated syndromic surveillance techniques can be expanded and evolve to address regional climate vulnerabilities.

Likewise, data derived from ED utilization coupled with socioeconomic and climate data can be used to identify vulnerability hot spots (ie, areas with both elevated exposure to climate-related hazards and high social vulnerability). Identifying hot spots enables efficient deployment of public health resources and facilitates regional health care system preparedness. For example, in Phoenix, AZ, large numbers of vulnerable patients reside in living facilities and group homes. Before expected heat waves, alerts are issued to case managers, nursing home staff, and first responders, educating to evaluate at-risk individuals.

Disaster Preparedness

Preparation for climate-related hazards and ED effects (eg, ED crowding, ambulance diversion, out-of-hospital care fragmentation) is a significant challenge that requires systemwide cooperation between public health, health care, and municipal communities. Numerous emergency physicians already lead with expertise in local and regional disaster preparedness. Preparedness is an iterative process that requires up-to-date, regional assessments that incorporate projected changes in the frequency and intensity of climate-related events and assessments of how such events will affect critical emergency services. Stress testing for health care systems is an ideal way to assess their ability to withstand shocks associated with extreme weather, population movements, and patient surges, specific to their communities and geographic region. Such formal exercises can anticipate and quantify increased patient demand, supply shortages, and evacuation plans through regional coordination with relevant agencies, including EMS, public health, and local and state government.

One of the most imminent threats to emergency medicine operations is patient surges caused by acute and unprecedented climate events. In recent years, literature has begun to emerge in regard to best practices for predicting and managing ED surges. Areas of active research include management and allocation of scarce resources, triage protocols, and workforce management. As best practices become established, we can adapt and improve our systems to increase our disaster readiness and resilience. At minimum, we can be consistent advocates that surge protocols should be visited and updated frequently by hospital disaster management teams.

Mitigation

Mitigation addresses the root cause of climate change, and thus reducing greenhouse gas emissions improves health and is something health care providers can encourage. Hospitals are among America’s most energy-intensive facilities, and EDs can play a major role in mitigating the effects of climate change by taking the initiative to reduce their own significant greenhouse gas emissions. Climate-smart health care can be both environmentally favorable and economically beneficial. In practice, US hospitals have saved $1 billion during 5 years by implementing simple energy-saving operational and equipment improvements. Blueprints to implement these types of cost-saving interventions are now widely available.
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<td>Extreme heat</td>
<td>Older adults</td>
<td>Medications such as diuretics, ( \beta )-blockers, antipsychotic drugs, anticholinergic agents, anxiolytics, and some antidepressants may impair resilience to heat stress and interfere with heat regulation. Clinicians should be aware of these adverse effects and counsel patients appropriately during heat events.</td>
<td>Ensure that vulnerable patients, such as elderly patients and those with disabilities, have access to an air-conditioned home environment, backup plans in case of a power outage, and access to cooling centers before discharge.</td>
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<td>Children</td>
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<td>Recommend a “buddy system” whereby vulnerable patients check in with a competent caregiver once per day.</td>
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<td>Pregnant women</td>
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<td>Ensure short-term primary care follow-up for at-risk patients with heat-sensitive comorbidities.</td>
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<td>Mentally ill</td>
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<td>Educate outdoor workers on the signs and symptoms of heat stress and critical interventions to prevent heat stroke.</td>
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<td>Soldiers</td>
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<td>Poor air quality</td>
<td>Patients with COPD, asthma, allergic disease</td>
<td>Ensure that patients with chronic respiratory diseases have access to respiratory medications at home or can fill their prescription before discharge, especially during periods of poor air quality.</td>
<td>Educate caregivers and patients to eliminate other common indoor triggers of respiratory disease, such as cigarette smoke.</td>
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<td>Outdoor workers</td>
<td>Educate patients on how to check air quality and modify their behaviors as a result.</td>
<td>Involve multidimensional team to aid in improving home indoor air quality by installing indoor air purifiers and sealing cracks in home.</td>
</tr>
<tr>
<td></td>
<td>Pregnant women</td>
<td>Recommend that caregivers keep vulnerable children and adults inside during days with poor air quality.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Older adults</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changes in vector ecology</td>
<td>Pregnant women</td>
<td>Perform detailed travel history, especially for patients presenting with vague illnesses.</td>
<td>Instruct pregnant women and outdoor workers to wear long pants and avoid early-morning and late-evening exposure to outdoor environments when vector insects are prone to feeding.</td>
</tr>
<tr>
<td></td>
<td>Displaced populations</td>
<td>Stay current with local public health disease advisories and report suspicious symptoms concerning for novel emerging diseases in your area to local public health departments.</td>
<td>Instruct women and men of childbearing age or in child-planning stages to avoid travel to high-risk VBD endemic areas (eg, Zika).</td>
</tr>
<tr>
<td></td>
<td>Outdoor workers</td>
<td>Maintain a broad infectious disease differential with a low threshold for treating and testing.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Children</td>
<td>Educate yourself on your hospital’s testing capabilities for zoonotic and vector-borne diseases.</td>
<td></td>
</tr>
<tr>
<td>Extreme weather events</td>
<td>Socioeconomically disadvantaged patients</td>
<td>Understand hospital and ED emergency preparedness plan, including what hospital functions are available on a backup generator.</td>
<td>Develop plans for patients during power outages, especially those with power-dependent equipment.</td>
</tr>
<tr>
<td></td>
<td>Older patients</td>
<td>Screen for mental health disorders in aftermath of extreme weather events.</td>
<td>Direct patients to available social resources.</td>
</tr>
<tr>
<td></td>
<td>Patients with disabilities</td>
<td>Maintain a high index of suspicion for novel diseases and carbon monoxide poisoning postevent.</td>
<td>Ensure patients without proper housing are taking precautions to avoid dangerous exposures such as carbon monoxide poisoning and insect exposure.</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

VBD, Vector-borne disease; EMR, electronic medical record.

**Research**

Given the breadth of the knowledge gaps in regard to the consequences of climate change on health and health care delivery pertinent to emergency medicine, there are numerous opportunities for evidence-based, scientific investigation, including adding a climate lens to existing research infrastructure (eg, effects of increasing temperatures on a disease process). Other examples include quantifying the health effects of climate-sensitive conditions on EDs, understanding climate change effects on health care systems and delivery of care; identifying best practices in climate resiliency and climate-smart health care
for EDs and health systems, developing an evidence base for adaptation such as implementing and evaluating early warning and surveillance systems, and furthering evidence-based climate disaster preparedness. A multidisciplinary approach, with involvement from disparate stakeholders, such as regional and national government agencies, facilities managers and engineers, private companies, and individual citizens, will engage necessary stakeholders. Greater knowledge about how the climate crisis affects our specialty will empower data-driven decisions and enhance technologies and collaborative action to improve and protect patient health.

Education
In recent years, medical education has either integrated climate medicine into existing curricula or created specific elective learning opportunities. Recently, an emergency medicine–based postgraduate fellowship program was established at both the University of Colorado and Harvard University. Such curricular changes and novel programs are consistent with goals and objectives laid out by the American Association of Medical Colleges and the Accreditation Council for Graduate Medical Education, which both require that learners understand the role of socioeconomic, environmental, cultural, and other population-level determinants of health in the health status and health care of individuals and populations.

Within the field of emergency medicine, there is a great opportunity to develop, disseminate, and share educational resources such as vetted curricula, online learning modules, distance learning programs, and elective opportunities in climate and health. At the medical professional level, there are analogous opportunities to educate clinicians from all specialties through continuing medical education.

CONCLUSIONS
The consequences of climate change are worsening health burdens and disrupting health care delivery, which presents complex challenges to the specialty of emergency medicine. Clinically, emergency medicine is experiencing an increased demand for services because of amplification of climate-related disease patterns. Given the current trajectory of greenhouse gas emissions, without urgent investment in adaptation and commitment to mitigation, patients—as well as health care systems and EDs—will become increasingly overwhelmed by the subsequent health effects. Emergency medicine, with its focus on urgent and emergency care, its role as a safety-net provider for vulnerable populations, and its expertise in disaster medicine, has the opportunity to pioneer innovative, nimble, and effective responses to these complex challenges.

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REFERENCES
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