Climate Migration and Wildfire Exposure Small Group Case AME Fall Meeting 2022
Dec. 7, 2022

General instructions:
1. Please read the clinical scenario below in your group. The case is not meant to be a medically comprehensive diagnostic conundrum but rather to focus on important climate health and equity themes.
2. There may be material that is brand new to you in this case and/or in the supporting resources provided. The goal is to introduce you to some examples of specific climate health and equity issues, facts and perspectives, not for you to develop a comprehensive understanding of this content area.
3. Please use the resources provided to learn more about relevant topics
4. Please write your responses in the jamboard to the 2 questions

Learning Objectives:
1. Describe how climate change creates conditions that cause populations to migrate
3. Define PM2.5, its relationship to air pollution and wildfire smoke and its role in causing harm to respiratory health
4. List actions that clinicians and patients can take to protect respiratory health in the setting of poor air quality
2. Apply a vulnerability framework that includes climate drivers, exposures, environmental/institutional context and social/behavioral context that impact health outcomes to understand the complexity of how climate change impacts health
5. Consider structural changes that healthcare professionals can advocate for that will support better health outcomes for this patient in the setting of climate change

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Case Scenario
Blanca Aguilar is a 37 year-old undocumented woman without health insurance who is originally from Guatemala. She speaks some English but prefers to communicate in Spanish. She has a history of type 2 diabetes mellitus and asthma and is presenting to your clinic to establish care.

Ms. Aguilar immigrated from Guatemala in late 2019, after years of drought destroyed the coffee crops at the plantation where she worked and made it very difficult to find food. When her husband was killed by local gangs, she and her sister Carmen decided to leave with Ms. Aguilar's daughter, Maria, who was 2 years old at the time.

They initially made their way to Ciudad Juarez in Mexico, where they waited for months in an encampment hoping to get crossing. They were denied multiple times and finally gathered enough money to pay a coyote for crossing. During this crossing, several other migrants died. She eventually found her way to Sonoma, California because she had a cousin who had moved there and was working in the vineyards picking grapes. This cousin found Ms. Aguilar a job picking grapes and she, her sister and her daughter moved in with her cousin and his family.

In the fall of 2020, wildfire struck the Sonoma area and Ms. Aguilar and other workers were told to continue picking grapes in the evacuation zone. Ms. Aguilar and other workers were not provided with N-95 masks. Because she was afraid of losing her job, she picked the grapes in the smoky conditions.

Ms. Aguilar has had pneumonia twice since 2020 and notes that her episodes of wheezing and shortness of breath are more frequent than they used to be, causing her to use her albuterol inhaler more frequently.

Ms. Aguilar recently moved to San Francisco in the hopes of finding work that was less physical and not outdoors. She, her daughter and her sister are temporarily staying with a family friend in a 2-bedroom apartment in the Mission, where 8 people are living.

Ms. Aguilar shares that she is feeling very stressed by her temporary living situation and inability to find work yet. She shares that she has had episodes of shortness of breath, palpitations and panic that come on without warning since she came to the United States. Additionally, she feels like her breathing is getting worse and worries that she will be unable to take care of her daughter if she gets sick.

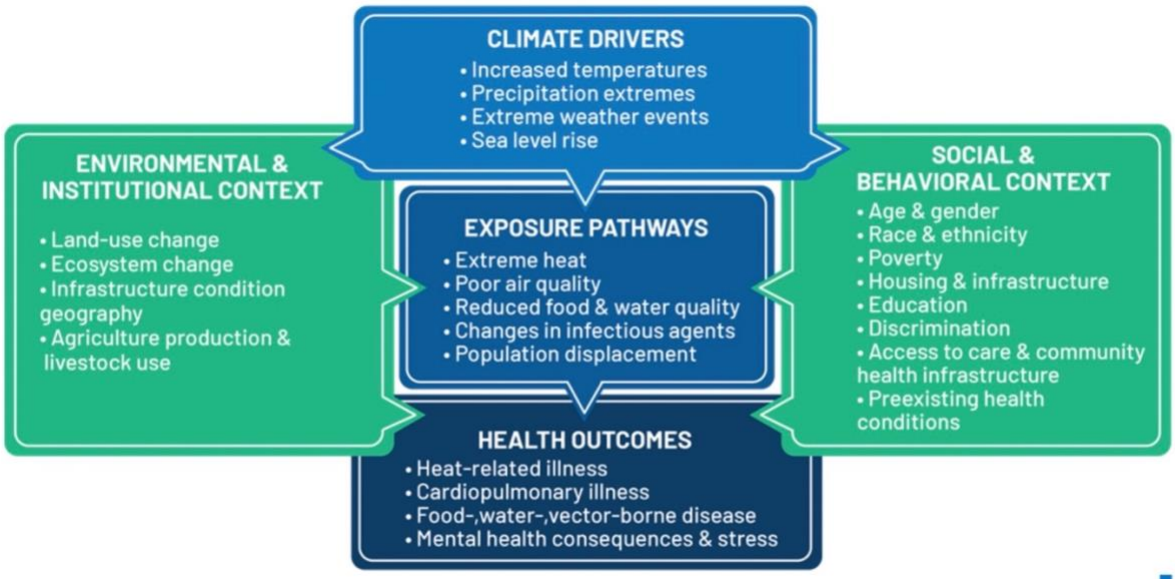
INSTRUCTIONS FOR QUESTIONS
See resources included below (after questions) for assistance in learning about climate health relevant topics for this case.

Please answer the questions below in the jamboard (link will be provided in the chat).

1) In thinking about how climate change might play a role in Ms. Aguilar's health and well-being, we can apply a vulnerability framework (see below). In Ms. Aguilar's case, what are:

a) climate drivers
b) exposure pathways
c) environmental and institutional context
d) social and behavioral context
e) health outcomes

When you go to the the jamboard, you will see the conceptual model below, a vulnerability framework. As you identify your answers to sections a) through e) above, please paste your answers near the appropriate section of the model.



SOURCE: Replication of *The Climate Change and Health* figure from The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment

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2) What are ways that we can intervene to address structural determinants that affect Ms. Aguilar's health, considering:

a) environmental context
b) institutional context
c) social context
d) behavioral context

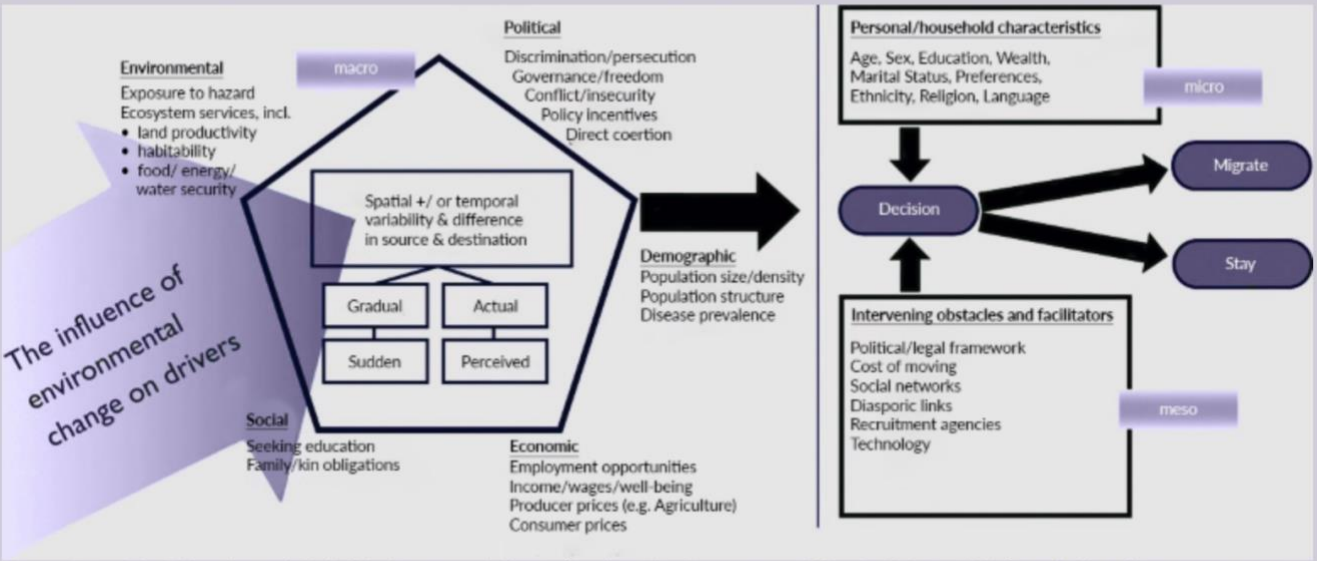
LEARNING RESOURCES FOR CLIMATE MIGRATION AND WILDFIRE CASE

A) How does climate change impact migration?

Climate change can contribute to worsening environmental factors such as drought, hurricanes, flooding that can contribute to food insecurity, loss of income, loss of shelter, as well as economic, political and social instability including violence. In these circumstances, some individuals and families are forced to migrate, usually initially internally, or within their country. However, if there are not enough opportunities for stability within the country, some people choose to migrate out of their country. These journeys can be dangerous, and particularly risky for women, children, the elderly and those with disabilities. In many countries, such as the United States, these people are not eligible for asylum and often remain undocumented and face multiple economic and political stressors exacerbated by their undocumented status. Lack

of documentation often places them in work situations in which they do not receive full protection from the law and established labor policies.

Figure 2. Environmental Drivers of Migration Decision-Making



Source: Foresight, *Migration and Global Environmental Change* (London: The Government Office for Science, 2011), available online.

B) What is small particulate matter and what role does it play in the pathophysiology of asthma and other respiratory illnesses?

Two types of small particulate matter are commonly discussed—the first is PM10 (Particulate Matter, 10 micrometer diameter) and the second is PM2.5 and smaller (2.5 micrometer diameter and smaller). These particles have small diameters, but large surface areas and are able to transport other harmful and toxic substances with them including elemental lead, sulfuric acid, etc. which are produced during the fossil fuel combustion process. In the lungs, small particulate matter travels to the level of alveoli.[4] Ultrafine particles smaller than 2.5micrometers in diameter can pass through the alveolar-capillary membrane and become disseminated in the bloodstream causing systemic side effects and can cause and exacerbate many adverse health conditions such as COPD, asthma, cardiovascular disease. Thus, the smaller the particle, the greater the systemic toxic effects. Direct tissue damage from induced inflammation and oxidative stress are the main pathophysiologic effects in the lungs. Small particulate matter can also interact with airborne allergens to trigger allergic asthma in susceptible patients.

Furthermore, the lung becomes damaged as it filters the small particulate matter and can accumulate in the lungs if the macrophages and lymphatic system become overwhelmed with clearing the PM. This can result in chronic lung inflammation and fibrosis.

C) What are associated short and long-term health effects of wildfire smoke exposure?
Wildfire smoke is rich in PM2.5, thus posing risk for local damage to lung tissue and systemic effects. Short-term effects of wildfire exposure include increased rates of respiratory events, hospitalizations and ER visits for asthma, COPD and respiratory infection. There is a dearth of data regarding long-term effects but there is concern that wildfire exposure might impact long-term lung capacity and overall physical functioning. This in an area of ongoing research.

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Table 1. Characteristics and Health Risks of Wildfire Particulate Matter.*

Feature	Description
Source	Wildfire particulate matter results from combustion of biomass.[27,28]
Particle size	The particles are smaller than those in particulate matter from urban sources (i.e., with a higher proportion of $PM_{2.5}$ and PM_1 in PM_{10}).[31]
Contribution to ambient particulate matter	In the continental United States in 2000 to 2016, wildfires were a contributing factor on 20% of the days that the daily $PM_{2.5}$ level exceeded the 24-hour standard (35 μg per cubic meter).[30] During the 2019–2020 Australian wildfire, the daily $PM_{2.5}$ level reached 600 μg per cubic meter in Sydney.[32]
Components and toxic effects	As compared with urban background particulate matter, wildfire particulate matter that reaches urban areas may contain more oxidative components (e.g., oxygenated PAHs and quinones) and proinflammatory components (e.g., aldehydes and oxides of nitrogen) and may have greater oxidative potential.[33] As wildfire smoke ages, the oxidative potential can more than double.[34] When wildfire particulate matter reaches urban areas, toxic effects on macrophage cells could be 5 times as intense as effects with the same dose of urban particulate matter, but the effects may vary according to combustion conditions and type of burned vegetation.[35]
Short-term health effects	
Mortality	There is consistent evidence of an increased risk of death from any cause but uncertain evidence of an increased risk of death from specific causes.[8,9,36] Wildfire particulate matter may have a stronger effect on mortality than urban particulate matter,[8,9,36,37] owing to the smaller particle size,[31] more abundant oxidative and proinflammatory components,[33] and amplifying effects of high temperature[17] and ozone.[38]
Morbidity	There is consistent evidence of an increased risk of respiratory events, including hospitalizations and emergency department visits due to asthma, chronic obstructive pulmonary disease, and respiratory infection.[8,9,36,39] Wildfire particulate matter has a stronger effect on the risk of asthma-related events than urban particulate matter.[33,40,41] Data are inconsistent regarding the risk of cardiovascular events,[8,9,36] but the effect may be similar to that of urban particulate matter.[41]
Risk of other health effects	Risks of low birth weight and preterm birth are increased.[8,9] Rates of influenza are increased.[42] Ambulance dispatches among people with diabetes are increased.[43]
Long-term health effects	Effects are largely unknown; wildfire particulate matter might impair lung capacity, self-reported general health, and physical functioning several years later.[44]
Vulnerable populations	Older adults, children, and pregnant women are more susceptible. People with preexisting cardiac or respiratory conditions (or both) have increased risks. People living in low-income areas have increased risks. Outdoor workers have increased exposure.

* Details regarding the short-term health effects of wildfire particulate matter are provided in Table S1 in the Supplementary Appendix, available at NEJM.org. Particulate matter with a diameter of 10 μm or less (PM_{10}) includes fine particles (diameter, ≤2.5 μm [$PM_{2.5}$]), submicronic particles (diameter, ≤1 μm [PM_1]), and ultrafine particles (diameter, ≤0.1 μm [$PM_{0.1}$]). PAH denotes polycyclic aromatic hydrocarbon.

D) What can you do to help protect Ms. Aguilar's respiratory health now?

In addition to treating Ms. Aguilar's asthma with evidence-based medical treatments, you can encourage her to use the Air Quality Index (AQI). The AQI is a nationally uniform color-coded index for reporting and forecasting daily air quality. It is used to report on the most common ambient air pollutants that are regulated under the Clean Air Act: ground-level ozone, particle pollution (PM_{10} and $PM_{2.5}$), carbon monoxide (CO), nitrogen dioxide ($NO_{2)}$, and sulfur dioxide (SO_2). The AQI is readily available on the AirNow website (https://www.airnow.gov/) or app, and can be used to guide Ms. Aguilar in decisions about whether to go outside, how long to stay outside and whether or not to use an N-95 mask. Additionally, you can identify whether or not she can get assistance in ensuring there is no mold in her home and in purchasing a HEPA air filter.

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Air Quality Guide for Particle Pollution

Harmful particle pollution is one of our nation's most common air pollutants. Use the chart below to help reduce your exposure and protect your health. For your local air quality forecast, visit www.airnow.gov

Air Quality Index	Who Needs to be Concerned?	What Should I Do?
Good (0-50)	It's a great day to be active outside.	
Moderate (51-100)	Some people who may be unusually sensitive to particle pollution.	**Unusually sensitive people:** *Consider reducing* prolonged or heavy exertion. Watch for symptoms such as coughing or shortness of breath. These are signs to take it easier. **Everyone else:** It's a good day to be active outside.
Unhealthy for Sensitive Groups (101-150)	Sensitive groups include **people with heart or lung disease, older adults, children and teenagers.**	**Sensitive groups:** *Reduce* prolonged or heavy exertion. It's OK to be active outside, but take more breaks and do less intense activities. Watch for symptoms such as coughing or shortness of breath. **People with asthma** should follow their asthma action plans and keep quick relief medicine handy. **If you have heart disease:** Symptoms such as palpitations, shortness of breath, or unusual fatigue may indicate a serious problem. If you have any of these, contact your heath care provider.
Unhealthy (151-200)	**Everyone**	**Sensitive groups:** *Avoid* prolonged or heavy exertion. Consider moving activities indoors or rescheduling. **Everyone else:** *Reduce* prolonged or heavy exertion. Take more breaks during outdoor activities.
Very Unhealthy (201-300)	**Everyone**	**Sensitive groups:** *Avoid all* physical activity outdoors. Move activities indoors or reschedule to a time when air quality is better. **Everyone else:** *Avoid* prolonged or heavy exertion. Consider moving activities indoors or rescheduling to a time when air quality is better.
Hazardous (301-500)	**Everyone**	**Everyone:** *Avoid all* physical activity outdoors. **Sensitive groups:** Remain indoors and keep activity levels low. Follow tips for keeping particle levels low indoors.

https://www.epa.gov/pmcourse/patient-exposure-and-air-quality-index