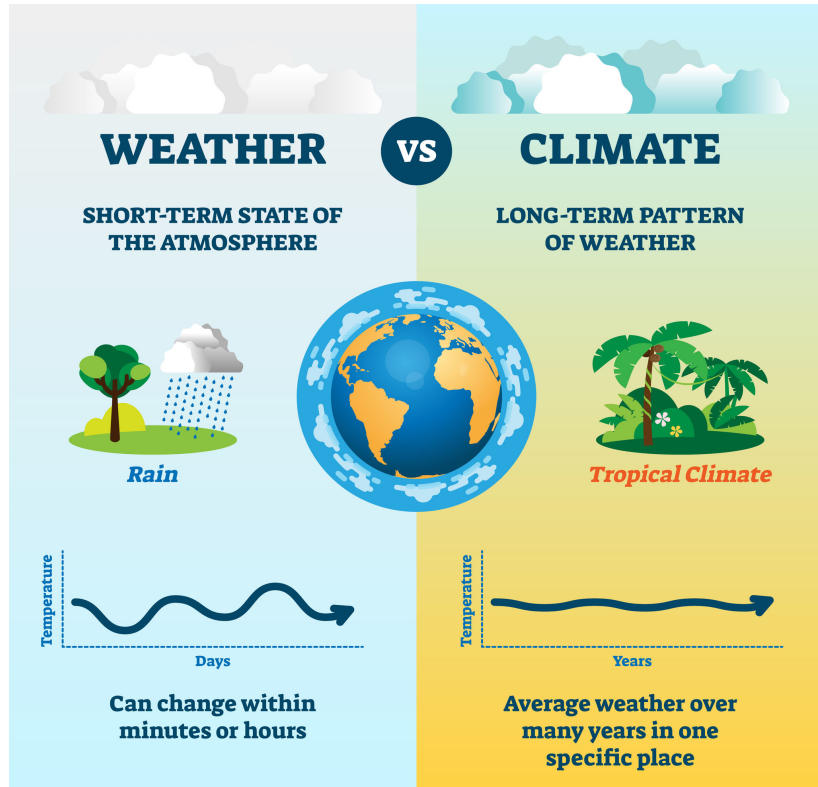


CHANGES IN SEASONAL WEATHER  
VARIATIONS AND IMPLICATIONS  
FOR RESPIRATORY HEALTH



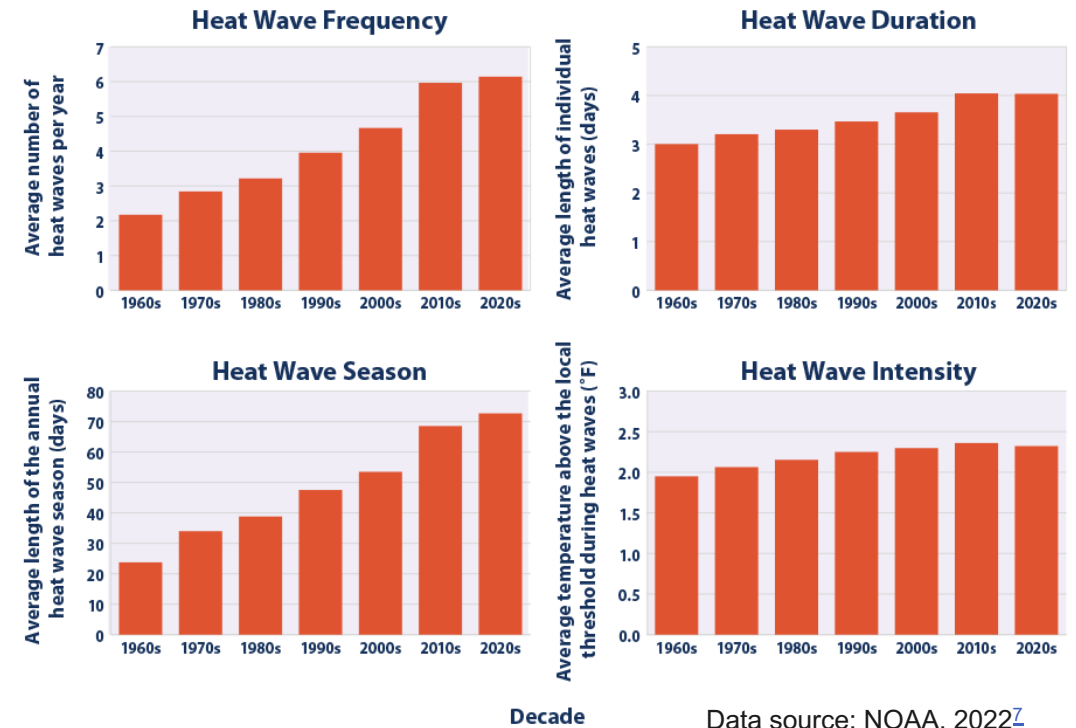
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Pulmonary & Critical Care Medicine



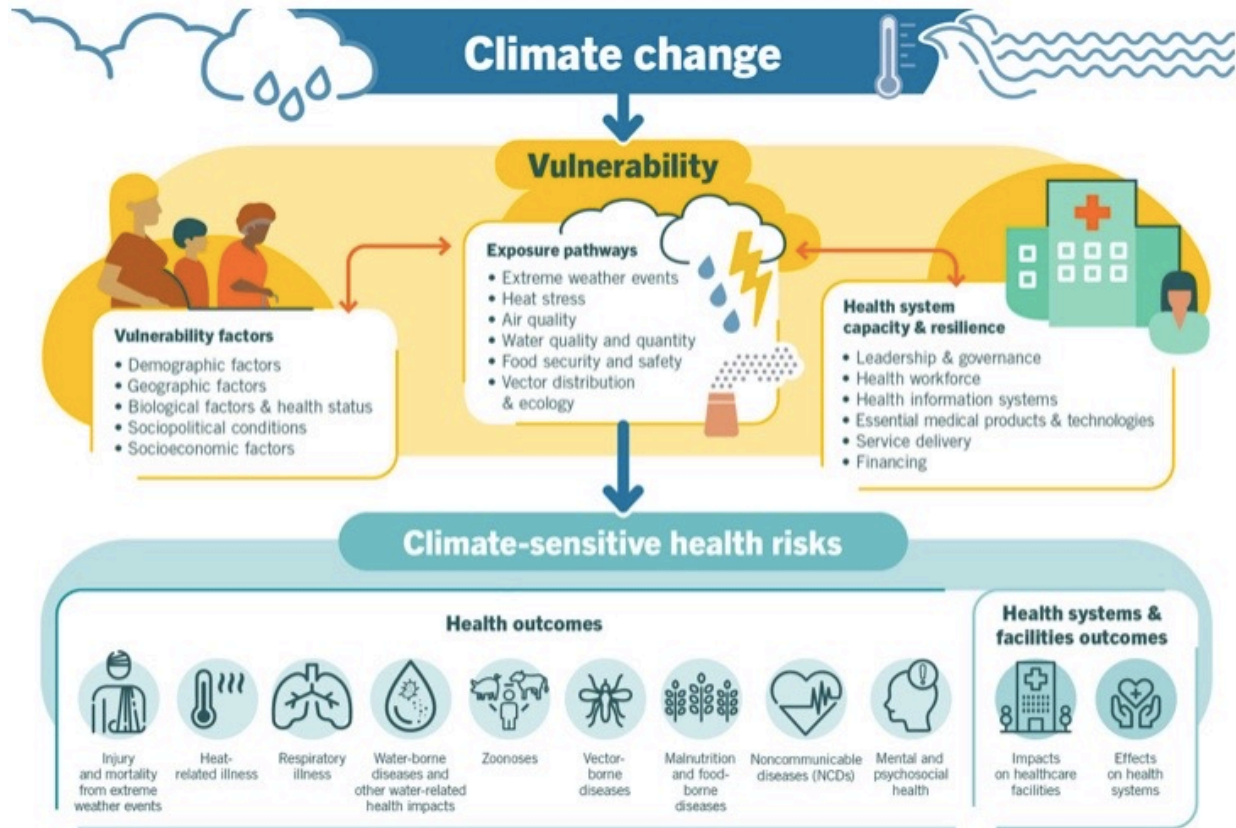
Precipitation  
 Droughts & Desertification  
 Temperatures (greenhouse gases – carbon dioxide, methane, nitrous oxide, black carbon and ozone)  
 Carbon Dioxide

**Figure 1. Heat Wave Characteristics in the United States by Decade, 1961–2021**



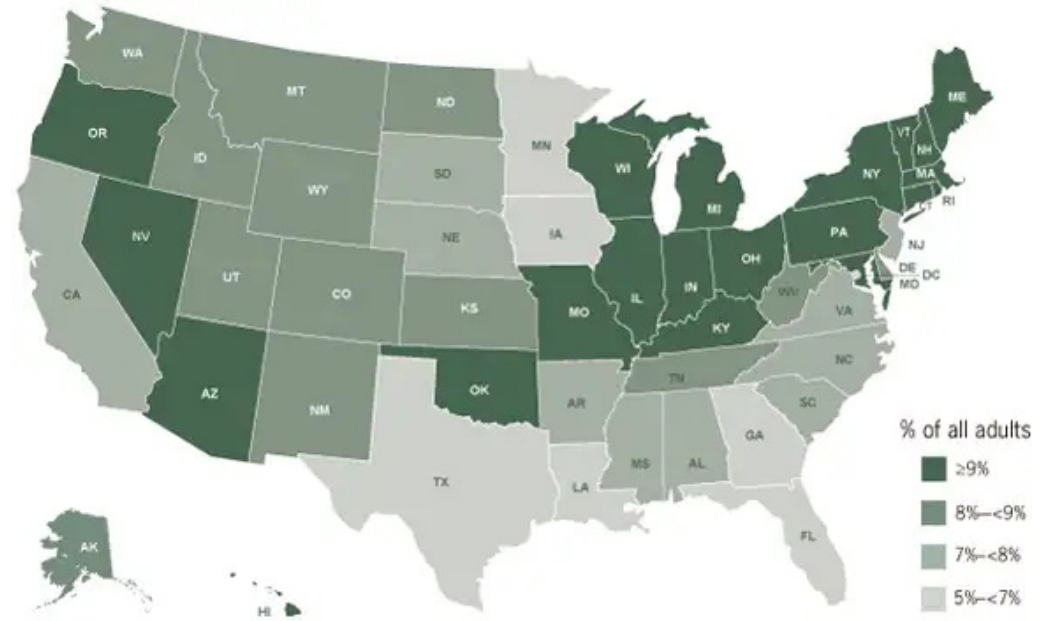
Data source: NOAA, 2022  
 Web update: July 2022

Each year in New Hampshire, there are an average of eight more days above 32 degrees Celsius compared to a century ago.



Asthma is increasing every year in the US.

Latest national data: Prevalence of 7.7%.

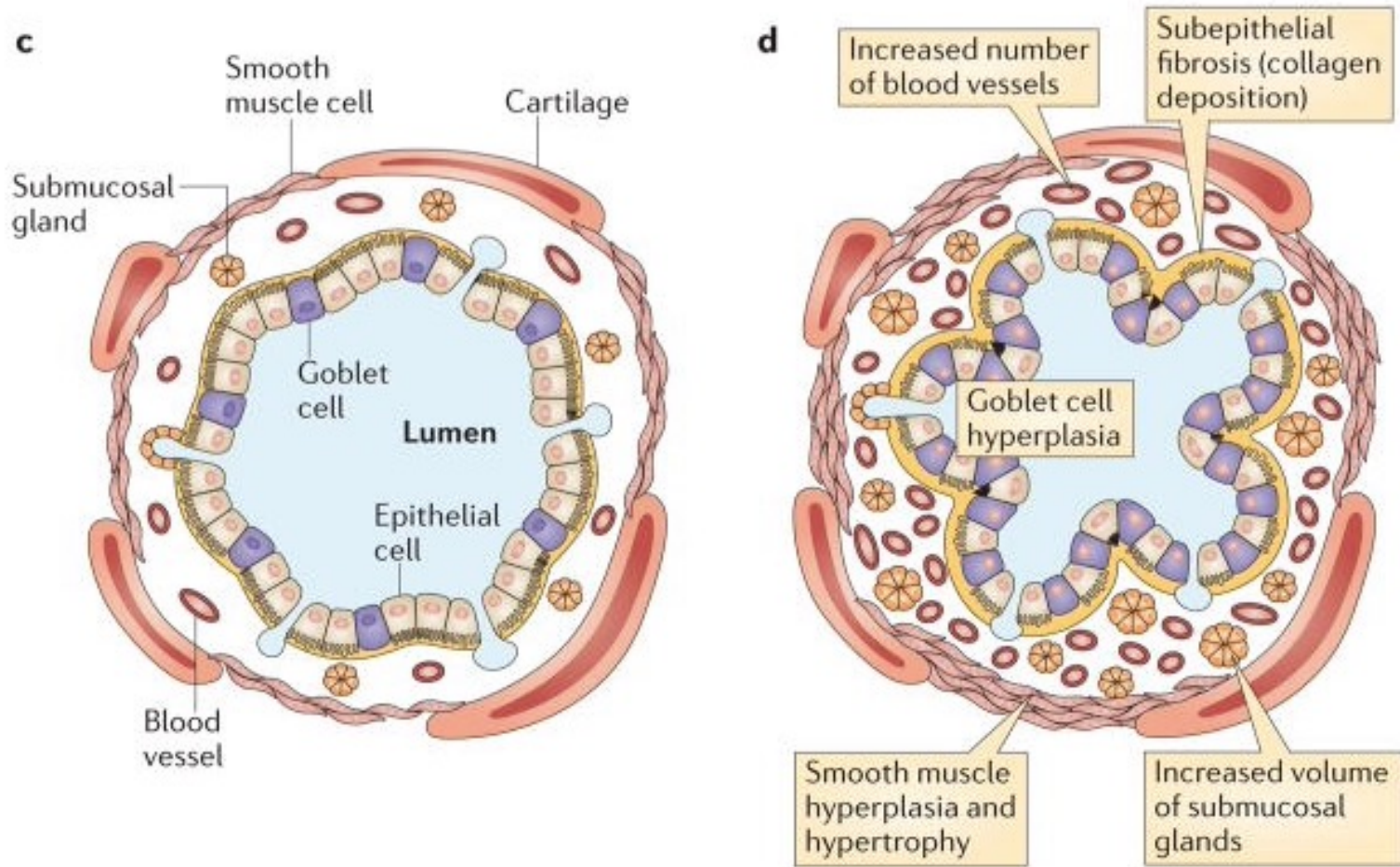


## RESPIRATORY DISEASES

ASTHMA

COPD

INTERSTITIAL LUNG DISEASES



Triggered by exercise, allergen or irritant exposure, changes in weather, or viral respiratory symptoms.

Not all asthma is the same.

~ 60% of all cases are thought to be triggered by allergens.

Variable symptoms, chronic inflammation and airway hyperresponsiveness.



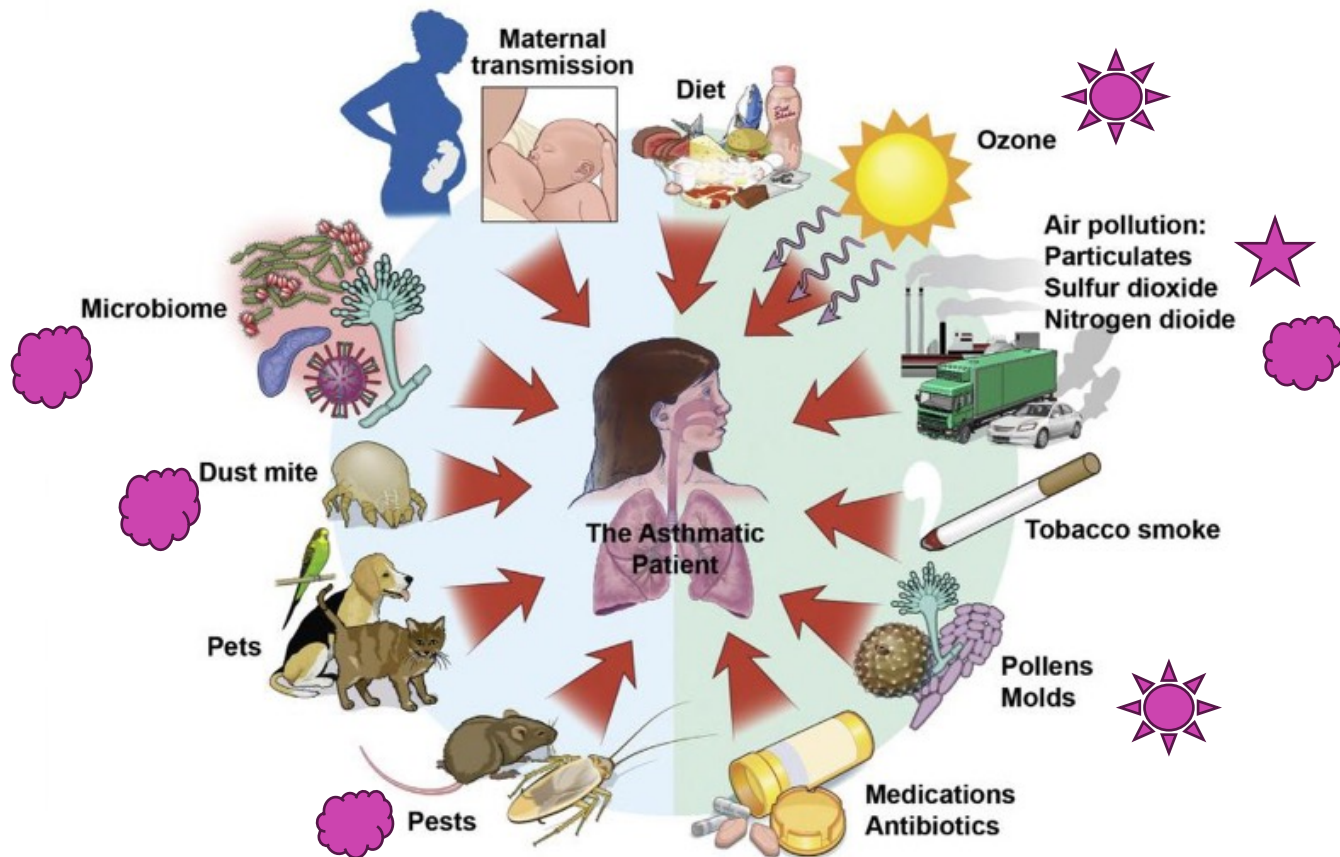


Fig. 1. The exposome concept considers all exposures of an individual in a lifetime and how those exposures relate to health.

THE ENVIRONMENT  
TO WHICH AN  
INDIVIDUAL IS  
EXPOSED IS  
CONTINUALLY  
INFLUENCING THE  
PATHOBIOLOGY OF  
ASTHMA



# OUTDOOR EXPOSURES

## *Pollen (one of the biggest implicated allergens)*

Outdoor Air Pollution (industrial, traffic, geographical)

## *Ozone (seasonal pollutant May –Sept)*

Particulate matter (year round; mix of suspended solid and liquid particles in air). Incomplete combustion. Combine with organic material.

Nitrogen Dioxide (Exhaust fumes, precursor of ozone)

Sulfur Dioxide (year-round)

Heat waves



Traffic-related air pollution (TRAP)



# Anthropogenic climate change is worsening North American pollen seasons

William R. L. Anderegg<sup>a,1</sup> , John T. Abatzoglou<sup>b</sup> , Leander D. L. Anderegg<sup>c,d</sup> , Leonard Bielory<sup>e,f,g</sup> ,  
Patrick L. Kinney<sup>h</sup> , and Lewis Ziska<sup>i</sup> 

PNAS 2021 Vol. 118 No. 7 e2013284118

- Wind pollen (trees, grasses & weeds) is a major contributor to allergic asthma.
- The clinical reactions depends on the allergenicity of the pollen, duration of exposure and volume of exposure.
- Pollen concentrations have increased by 21% across North America (since 1990)
- Season is 20 days longer (since 1990)
- Anticipate that by the end of the century, season could start 40 days sooner and pollen could increase by 250%.
- Higher temperatures are making pollen more immunogenic. (Birch)

Ragweed season has lengthened from 13 days to 27 days since 1995<sup>2</sup>

Increased temperature and carbon dioxide resulted in bigger ragweed plant and more pollen.



The Spruce / K. Dave





...d waters rush around a house in Long Island, New York. (photo credit: USGS).



Poor air quality – increased particulate matter, organic and inorganic matter.

Heat

Mold

Humidity

Diesel and gasoline generator fumes, rodents, cockroaches

Poor air quality – increased particulate matter, hazardous air pollutants (PM<sub>2.5</sub>, NO<sub>2</sub>, ozone, aromatic hydrocarbons or lead).

Heat

DISPLACEMENT



VULNERABLE PERSONS/POLUPLATIONS  
(Urban, less resources, less access, children, elderly, laborers, ethnic and racial groups, LSES, overall population health)



SPEND MORE TIME INDOORS  
SHELTER CONDITIONS  
(crowded, service animals)



# INDOOR EXPOSURES

Indoor particulate matter

Allergens (carpets, house plants)

Chemical pollutants (tighter houses)

VOCs (furniture, construction materials)

Nitrogen dioxide (gas stoves, furnaces)

House dust mites (humidity, higher temperatures)

Cockroaches (damp, dense populations, urban, LSES)

Molds (humidity)

Rodents (mice, rats, guinea pigs)

Pets

Smoking (including second and thirdhand)

Fireplace, pellet stoves



# Opportunities For Change



Awareness

Education

Collaboration

Policy

Maternal Health

Early Childhood  
Exposures

Indoor Environments

Housing – hard surface  
flooring, central air,  
filtration, venting

Re-thinking norms –  
Shorter time outdoors,  
bathing, changing after  
being outdoors,  
removing shoes

Increase access

# References

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1. Impact of weather and climate change with indoor and outdoor air quality in asthma: A Work Group Report of the AAAI Environmental Exposure and Respiratory Health Committee. Poole, J. et al. Journal of Allergy and Clinical Immunology, The, 2019-05-01, Volume 143, Issue 5, Pages 1702-1710.
2. Ziska L., Knowlton K, Rogers C, et al. Recent warming by latitude associated with increased length of ragweed pollen season in central North America. Proc Natl Acad Sci USA 2011; 108 (10):4248-51.