

North Carolina Climate and Health Adaptation Plan

In 2012, the North Carolina Climate and Health Adaptation Plan was developed. Since then, additional climate and health work has led the North Carolina Division of Public Health's Occupational and Environmental Epidemiology Branch to update the 2012 Adaptation Plan with current priorities. These priorities were developed using vulnerability assessments, disease burden projections, and intervention assessments.

As part of the Building Resilience Against Climate Effects (BRACE) framework, branch staff developed the North Carolina Climate and Health Profile Report, which builds on the Adaptation Plan and describes the leading climate-related risks and their associated public health impacts in the state^{1,2}. The Climate and Health Profile Report prioritizes the health impacts using the Hanlon Method, a complex method for determining priorities by assigning numerical values to available data categories³. This prioritization identifies air quality and respiratory disease along with heat related deaths and illnesses as the top climate and health priorities for North Carolina¹.

Air quality and respiratory impacts of climate include impacts from ambient air quality, primarily ozone and fine particulate matter⁴. In addition, impacts of climate on indoor air quality were also considered. Disease burden projections for ozone and fine particulate matter in North Carolina indicate that health impacts from transportation and industry source pollution will stabilize or decrease by 2025⁵. While indoor air quality impacts of climate are important, Branch staff were unable to systematically measure vulnerability in this area or project disease burdens. However, indoor air quality issues from wildfires will be addressed by wildfire smoke intervention work. Fine particulate matter from wildfires is an existing threat to North Carolinians' health, and the combination of ecological changes, increases in heat exposures, and more precipitation variability will contribute to future climate and health impacts from wildfire smoke^{6,7}. **Therefore, in the top priority area of air quality and respiratory disease, staff will focus on wildfire smoke health impacts.** Wildfire smoke results from a variety of climate factors, including extensive heat and drought. Wildfires may cause major health concerns directly to those in surrounding areas, but also many who are quite a distance from the site of the fire^{1,7}. The 2008 and 2011 Eastern North Carolina wildfires resulted in downwind increases in respiratory and cardiovascular emergency department visits⁷.

Heat-related illnesses and deaths are directly related to climatic patterns, and heat-related illnesses and deaths are a serious environmental health concern in North Carolina. The vulnerable population for heat-related illnesses is males 25-64 years of age living in rural areas, potentially as a result of occupational exposures^{6,8,9,10,11}. Disease burden projections for heat-related illnesses and deaths in North Carolina indicate that health impacts from heat will increase by 2025⁵. The most sensitive measure of heat-related illness available in North Carolina is heat-related illness emergency department visits. **Therefore, the secondary priority area for health adaptation will be heat-related illness emergency department visits.**

In collaboration with the Environmental Protection Agency and the State Climate Office, staff conducted vulnerability Geographic Information Services (GIS) mapping, as part of the vulnerability assessment. Population vulnerability to health impacts from fire smoke exposure is determined from GIS mapping for exposure, sensitivity, and adaptive capacity. In collaboration with the Southeast Regional Climate Center, population vulnerability to health impacts from heat is determined by the ratio of individuals who visit local emergency departments to the population density. Risk factors may differ due to location, including population density, socioeconomic status, and ethnicity¹¹.

In the last two decades, heat related illness has caused the largest number of fatalities due to weather related events¹². With climate patterns, temperature trends predict that there will also be a rise in the number and intensity of extreme heat related events, such as heat waves. Modeling indicates that heat-related emergency department visits and fatalities will likely increase. Interventions can be put into place to help reduce the risk of heat related illnesses¹³.

The following table describes evidence supported interventions for reducing the negative health outcomes related to inhalation of wildfire smoke. Results were found through literature review of keyword web database searches

through Web of Science and Google Scholar¹⁴. Keywords such as response, intervention, fire, and respiratory provided the best results. From these literature reviews, interventions were assessed based on the amount of scientific support available.

| Wildfire Smoke Interventions Error! Bookmark not defined. | | |
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| Intervention | Description | Evidence* |
| Evacuation ¹⁵ | Evacuation consists of urgent removal of individuals from an area, such as a building or a community, when there is an immediate risk to human health and safety. Evacuation as an intervention for wildfire smoke can include entire populations or sub-populations of vulnerable individuals who are particularly susceptible to health effects from smoke exposure. | Scientifically supported |
| Air Filtration and Cleaners-Home, Room, Facility ^{16,17, 18,19} | Filtration is defined as “the removal of particulate matter from air using an air-handling system and a filter (or a bank of filters).” Air cleaning is “the removal of gaseous contaminants from air using an air-handling system and sorbent filters (such as granular activated carbon, potassium permanganate impregnated alumina and impregnated carbon).” | Scientifically supported |
| Personal Air Masks Error! Bookmark not defined. Error! Bookmark not defined. ²⁰ | Respirator masks, or “particulate respirators”, (which look like paper masks) can filter out 95% of particulates that are 0.3 microns and larger, therefore filtering a significant portion of smoke. Respirator masks labeled “R95”, “N95”, or “p95”, of soft masks with higher ratings (R, N, or P99 and R, R, or P1000) will filter our most particles associated with wildfire smoke. Respirators with purple HEPA filters offer the highest protection. Personal air masks may not be appropriate for all populations, depending on underlying health conditions. Fit testing is needed to ensure proper mask functioning. | Some evidence |
| Forecast/Warning Systems ²¹ | A wide variety of agencies at a state and national level conduct air quality forecasting.. These forecasting symptoms usually use an Air Quality Index (AQI) for reporting and forecasting daily air quality. The EPA, in conjunction with NOAA, calculate the AQI for five major pollutants; ground-level ozone, particulate pollution (particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. | Some evidence |
| Public Service Announcements Error! Bookmark not defined. | A Public Service Announcement (PSA) is a message to the public disseminated by the media with a primary purpose of informing and educating the public. PSA’s could be utilized to spread messages informing the public of the health risks of wildfire smoke inhalation and prevention measures to protect lungs or air quality forecasts. | Some evidence |

Note: Chart and research by Florida Department of Health. Article: Wildfire Smoke Public Health Interventions (2015)

The intervention report published by the New York State Department of Health provides new information about evidence-based heat interventions. The department conducted a systematic review of relevant literature found through keyword searches on PubMed, Google, and Google Scholar. The review identified six interventions to reduce heat-related illness:

| Heat Related-Illness Interventions ¹³ | | |
|--|--|--------------------------|
| Intervention | Description | Evidence* |
| Heat Alert System ^{22,23,24,25,26,30,35,41,42,43,44,45} | <i>Heat alert system</i> refers to a city or municipality preparing a comprehensive plan that is activated when temperatures are at or exceed a threshold that is dangerous for the health of their citizens. The systems often have levels of incremental activities based on temperatures or heat advisories issued by the governmental agency that provides weather forecasts and warnings. | Scientifically supported |
| Education and Information ^{23,24,25,27,28,30,31,41,42} | <i>Education and information</i> is when health departments, municipalities, cities, etc. provide information about what heat related-illness is and how to prevent, identify, and treat it. | Some evidence |
| Access to Cooling ^{14,29,30,31} | <i>Access to cooling</i> refers to making air conditioned places publicly available for those who do not have access to air conditioning. | Some evidence |
| Real-Time Data Syndromic Surveillance and Warnings ^{27,32,33,34,35} | <i>Real-Time Data Syndromic Surveillance and Warnings</i> consists of monitoring ambient heat-related hospitalizations, emergency room visits, 9-11 calls, and meteorological data to recognize when the number of heat related-illness symptoms or diagnoses is higher than normal and the health department can then issue warnings to the public. | Little evidence |
| Built Environment ^{36,37} | <i>Built environment</i> refers to the part of the physical environment created and constructed by humans designed to reduce outdoor and indoor temperature. A potential built environment intervention may be urban tree canopy. | Insufficient evidence |
| Zoning/Building Regulations ³⁸ | <i>Zoning/Building Regulations</i> are city or municipality ordinances that guide or require developers to include infrastructure designed to reduce ambient and indoor heat in residential or commercial development plans. | Insufficient evidence |

*Scientifically supported: This includes one or more systematic review(s), or at least: three experimental studies, or three quasi-experimental studies with matched concurrent comparison. These studies have strong designs and statistically significant positive findings³⁹.

*Some Evidence: This includes one or more systematic review(s), or at least: two experimental studies, or two quasi-experimental studies with matched concurrent comparisons, or three studies with unmatched comparisons or pre-post measures. Compared to “Scientifically Supported” studies, these have less rigorous designs and limited effects³⁹.

*Insufficient evidence: Generally has no more than one experimental or quasi-experimental study with a matched concurrent comparison, or two or fewer studies with unmatched comparisons or pre-post measures. Strategies within this rating often have varying study quality and findings³⁹.

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